The MMPI Factor Scales and risk of death in men during 45 years of follow-up

The MMPI Factor Scales and Risk of Death in Men during 45 Years of Follow-Up: The Western Electric Study

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Data and code used to create the personality content factor scores are located at https://osf.io/ghjy5/.

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Abstract

We examined associations between personality traits measured in 1958 and both all-cause and cause-specific mortality assessed 45 years later in 2003. Participants were 1862 middle-age men employed by the Western Electric Company. Outcomes were days to death from all-causes, coronary heart disease, stroke, cancer, and causes other than circulatory diseases, cancer, accidents/homicide/suicides, or injuries (other causes). Measures in 1958 included age, education, health behaviors, biomedical risk factors, and nine content factors identified in the Minnesota Multiphasic Personality Inventory. Four content factors---neuroticism, cynicism, extraversion, and intellectual interests---were related to the Five-Factor Model domains of neuroticism, agreeableness, extraversion, and openness, respectively. The remaining five---psychoticism, masculinity versus femininity, religious orthodoxy, somatic complaints, and inadequacy---corresponded to the Five-Factor Model's facets and styles (combinations of two domains) or were unrelated to the Five-Factor Model. In age-adjusted and fully-adjusted models, cynicism was associated with greater all-cause and cancer mortality. In fully-adjusted models, inadequacy was associated with lower all-cause mortality and lower mortality from other causes. In age-adjusted models, religious orthodoxy was associated with lower cancer mortality. Further analyses revealed that the association between cynicism and all-cause mortality waned over time. Exploratory analyses of death from any disease of the circulatory system revealed no further associations. These findings reveal the importance of cynicism (disagreeableness) as a mortality risk factor, show that cynicism-mortality associations are limited to certain periods of the lifespan, and highlight the need to study personality styles or types, such as inadequacy, that involve high neuroticism, low extraversion, and low conscientiousness.

Keywords: cancer, circulatory, mortality, personality, MMPI, Western Electric

Introduction

Personality traits are stable, heritable patterns of thinking, feeling and behaviors, including interactions with others, ways of perceiving the world, including one's self, and how one reacts to joyous events and upheaval (Costa, McCrae, & Löckenhoff, 2019). One might therefore expect that personality traits, singly and in combinations, play a role in health and aging, and that their role may change over the lifespan.

The literature on personality and health has shown that personality traits are associated with health-related behaviors and health outcomes (Deary, Weiss, & Batty, 2010; Strickhouser, Zell, & Krizan, 2017). Prominent among these studies are those that investigated relationships between personality traits and all-cause mortality. Reviews of this literature and meta-analyses have identified low conscientiousness (Jokela et al., 2013; Kern & Friedman, 2008; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007), low agreeableness (Roberts, et al., 2007), high neuroticism (Roberts, et al., 2007), low extraversion (Roberts, et al., 2007), and low openness (Ferguson & Bibby, 2011) as being associated with greater mortality. Save for the association between openness and all-cause mortality, the conclusions of these reviews and meta-analyses were supported in a recent study of 15 longitudinal datasets collected in 5 countries comprising participants from around 20 to 104 years in age with mean survival follow-up times of around 6 to 41 years (Graham et al., 2017).

To better understand the relationships between personality and mortality, researchers have examined relationships between personality and specific causes of death. For instance, in their cohort study of 1877 40 to 55 year old, mostly white, men, Shekelle, Gale, Ostfeld, and Paul (1983) found an association between higher scores on the Cook and Medley hostility scale (1954), a measure of low agreeableness (Barefoot, Dodge, Peterson, Dahlstrom, & Williams, 1989), and 10-year incidence of myocardial infarctions or death from coronary heart disease. This association prevailed adjusting for biomedical (e.g., systolic blood

pressure) and behavioral (e.g., smoking) risk factors (Shekelle, et al., 1983). In the same study, Shekelle et al. examined the relationship between hostility and mortality over a 20-year period. In addition to investigating all-cause mortality, Shekelle et al. investigated death from coronary heart disease, death from cancer, and death from causes other than cardiovascular-renal disease and cancers. In unadjusted models, hostility was related to total deaths and deaths from each of the specific causes, but in models that adjusted for biomedical and behavioral risk factors, hostility was only related to all-cause mortality.

A study by Almada et al. (1991) of 1871 men in the same cohort examined relationships between 25-year mortality and both neuroticism and cynicism, the latter being related to low agreeableness (Barefoot, et al., 1989; Costa, Busch, Zonderman, & McCrae, 1986). Mortality outcomes in Almada et al.'s study included death from coronary heart disease, death from other cardiovascular diseases, and death from cancer, death from other causes, and deaths from all causes. Neuroticism was associated with a greater risk of death from other causes and all-cause mortality, but these associations did not prevail in fully-adjusted models that included biomedical risk factors, behavioral risk factors, and cynicism. Cynicism was associated with greater risk of coronary death and death from all-causes, and both associations prevailed in fully-adjusted models; cynicism was also related to death from cancer, but this association did not prevail adjusting for other variables. Death from other cardiovascular diseases was not associated with either personality trait.

More recent work also examined associations between personality traits and specific causes of death. A cohort study of over 41,000 men and women in Japan with a mean age of around 51 years tested for associations between the four traits measured by the short-form Eysenck Personality Questionnaire-Revised (EPQ-R; Eysenck, Eysenck, & Barrett, 1985) and deaths over 11 years from coronary artery disease and stroke (Nakaya et al., 2005). Neither EPQ-R neuroticism, extraversion, psychoticism (low agreeableness and low

conscientiousness; McCrae & Costa, 1985), nor lie (low neuroticism and high conscientiousness; McCrae & Costa, 1985) scale scores were related to mortality.

A 21-year follow-on study (Shipley, Weiss, Der, Taylor, & Deary, 2007) of a cohort of over 5000 British men and women aged 18 to 94 years examined associations between brief measures of extraversion and neuroticism (Eysenck & Eysenck, 1964) and mortality. Extraversion was not significantly related to any specific mortality outcome and neuroticism was associated with death from cardiovascular disease and death from coronary artery disease deaths, although these associations did not prevail in models that adjusted for additional covariates. Neuroticism was not associated with deaths due to stroke, respiratory disease, lung cancer, and all other cancers.

A 15-year follow-up study by Jonassaint et al. (2007) of 977 mostly male patients whose mean age in years was 59.8 (SD = 9.3) and who had significant coronary artery disease, examined the relationships between openness and its facets (Costa & McCrae, 1985). The authors found that, although openness was not related to cardiac death, two of the six facets, namely, openness to feelings and openness to actions, were protective.

Another study tested whether either optimism or cynicism were related to death from coronary heart disease, cardiovascular disease, or cancer in 97,253 black and white post-menopausal women (Tindle et al., 2009). The authors of the study found that optimism, which is related to lower neuroticism and higher extraversion, agreeableness, and conscientiousness (Sharpe, Martin, & Roth, 2011), was associated with reduced death from coronary heart disease and cardiovascular disease; cynicism was associated with greater risk of cancer death.

Two studies of multiple cohorts examined relationships between the Five-Factor Model and cause-specific mortality. One examined personality and death from stroke or coronary heart disease in 24,543 men and women with a mean age of about 61 years, and 3 to

15 years of follow-up time (Jokela, Pulkki-Raback, Elovainio, & Kivimaki, 2014). Analyses revealed that coronary heart disease death was related to higher neuroticism and lower conscientiousness and that stroke death was related to higher extraversion and lower conscientiousness. The other study examined personality and death from cancer over around 5.4 years in 42,843 men and women whose ages ranged from 16 to 104 years (Jokela et al., 2014). The authors of that study found no significant associations between personality and mortality.

Possible mechanisms that explain associations between personality and mortality have been proposed (see Deary, et al., 2010 for a revew). One possibility is that these associations are attributable to common genes that influence personality and health outcomes. Personality traits in these models are thus markers of genetic risk for poor health and early death. Indirect support for this explanation comes from a longitudinal study that found that non-normative age-related changes, that is, declines, in agreeableness were related to higher allostatic load (Stephan, Sutin, Luchetti, & Terracciano, 2016). Direct evidence comes from two genetic studies. The first was a twin study by Mosing et al. (2012), which found that genetic influences related to longer life were related to pessimism, a measure of neuroticism (Marshall, Wortman, Kusulas, Hervig, & Vickers, 1992), and the psychoticism scale of the Revised Eysenck Personality Questionnaire (Eysenck, et al., 1985). The second study was a genome-wide association study that found common genes related to neuroticism and parental age of death, and several health outcomes, such as coronary artery disease (Hill et al., 2019).

Another possible explanation is that personality is associated with behaviors that lead to poorer health and earlier death. Evidence supporting this explanation includes studies and a second-order meta-analysis that found associations between personality and health-related behaviors. For example, higher extraversion was positively associated with physical activity and both higher conscientiousness and higher agreeableness were associated with being more

safety conscious when driving, engaging in less risky sexual behavior, abstaining from smoking, and drinking only in moderation (Strickhouser, et al., 2017). Other studies include ones by Brummett, Siegler, Day, and Costa (2008), Mõttus et al. (2012), and others (e.g., Lunn, Nowson, Worsley, & Torres, 2014) that showed that higher openness and higher conscientiousness were both related to having a healthier diet.

Further evidence that the personality-mortality relationship is mediated by health behaviors comes from studies of health outcomes other than mortality. For example, a longitudinal study of personality and body mass index (BMI) revealed that baseline levels were related to higher neuroticism, extraversion, and openness, and lower conscientiousness and agreeableness, but that a more rapid rate of increase was related to lower agreeableness (Sutin, Ferrucci, Zonderman, & Terracciano, 2011). Additional support comes from two studies that found relationships between personality and lipid levels. The first, by Sutin et al. (2010), found that, in men and women living in Sardinia, lower high-density lipoproteins (good cholesterol) levels and higher triglyceride levels were related to lower conscientiousness; higher openness was also related to elevated levels of triglycerides. This study also found that clinical thresholds of high-density lipoproteins and triglycerides that are indicative of good health were related to higher conscientiousness. In the other study, Roh et al. (2014) found that, among Korean women, higher neuroticism was related to lower levels of high-density lipoproteins and that higher conscientiousness was related to a reduced likelihood of having clinically significant levels of total cholesterol. Finally, two studies of personality and interleukin-6 found that lower conscientiousness were related to higher levels of this inflammatory marker (Sutin et al., 2009; Turiano, Mroczek, Moynihan, & Chapman, 2013). Sutin, et al. (2009) also found that this association was attributable to cigarette smoking and that higher neuroticism was also linked to higher interleukin-6 levels.

Research on the relationships between personality and health, such as the studies described above, have typically worked under the assumption that these associations do not change over the lifespan. This assumption may have come about because personality traits are mostly stable in adulthood (Anusic & Schimmack, 2016; Roberts & DelVecchio, 2000). However, personality-mortality associations may change over time, even if personality does not, and there is evidence to support this possibility. For one, a meta-analysis found that the effect size of conscientiousness, which is believed to have the strongest relationship with reduced mortality, diminishes over time (Kern & Friedman, 2008). Furthermore, a study of personality and mortality in the participants of a Medicare demonstration found that the importance of conscientiousness declined whereas that of agreeableness increased (Costa, Weiss, Duberstein, Friedman, & Siegler, 2014).

That the relationship between personality traits and mortality may change over time should not be surprising. For one, how personality is expressed may differ across the lifespan. For example, in early adulthood people low in agreeableness may react angrily and openly to perceived slights whereas older individuals may only seethe inwardly, and these different behaviors may have different consequences to one's health. Second, normative changes in personality (Roberts, Walton, & Viechtbauer, 2006), such as increases in conscientiousness, and the consequent change in health-related behaviors, may lead to a situation where many members of a cohort are at greatly reduced risk or even no longer at risk. Third, personality traits may be uniquely related to specific causes of death for specific age groups or periods in the lifespan. For example, personality and coronary death may only be weakly related in the early part of the follow-up when participants are relatively young, but more strongly related at later follow-ups or ages. Fourth, some personality traits may be more related to managing one's health at older ages than at younger ages. For example, traits, such as agreeableness, may take on more importance in older age as social resources and interactions with caregivers

become more important (cf. Costa, et al., 2014). Fifth, in cohort studies, personality traits may be more strongly related to mortality during the normal range of life expectancy than they are for cases of premature mortality or in long-term survivors. Finally, historical trends, such as medical advances in detecting and treating diseases may prolong life, and increased knowledge about how to take care of one's health, may lead to a reduction in the strength of these associations across time periods.

The failure to account for time-related differences such as these has been cited as a limitation of previous studies on personality and mortality, particularly as it makes identifying causal mechanisms difficult (Friedman, 2019). To gain a better understanding of how much and what kind of variation over time there is in personality-mortality associations, we examined these associations over a 45-year follow-up of the Western Electric Study cohort. As noted before, the earlier 20- and 25-year follow-ups of this cohort revealed associations between hostility and incident coronary heart disease and all-cause mortality (Shekelle, et al., 1983), and between cynicism and both death from coronary heart disease and from all causes (Almada, et al., 1991).

Our study had two aims. The first was to build on previous studies of this cohort and on the wider personality-mortality literature by examining associations between mortality and personality. To do so we examined both all-cause and cause specific mortality and nine factor scales based on personality content factors identified by Costa, Zonderman, McCrae, and Williams (1985) in a principal component analysis of the Minnesota Multiphasic Personality Inventory (MMPI; Hathaway & McKinley, 1943).

Previous studies of the Western Electric Study cohort mostly tested for relations of low agreeableness, represented by cynicism or hostility scales, and/or neuroticism, to mortality (Almada, et al., 1991; Shekelle, et al., 1983). The main focus of the present study was on the factor scales for neuroticism, extraversion, intellectual interests, and cynicism as

these content factors are related (see Table S1) to four Five-Factor Model domains (Costa, Busch, et al., 1986). Briefly, neuroticism, extraversion, intellectual interests, and cynicism correspond to the NEO Personality Inventory (NEO-PI; Costa & McCrae, 1985) domains neuroticism, extraversion, openness to experience, and (low) agreeableness, respectively (Costa, Busch, et al., 1986). Although conscientiousness, the fifth major human personality domain, was not represented in the MMPI (Costa, Busch, et al., 1986), its association with reduced mortality risk has been reported by many studies (Kern & Friedman, 2008; Strickhouser, et al., 2017).

We also tested for associations between mortality outcomes and the remaining factor scales---inadequacy, religious orthodoxy, psychoticism, somatic complaints, and masculinity versus femininity. Our decision to do so was predicated upon correlations (see Table S1) between these content factors and the NEO-PI (Costa, Busch, et al., 1986) that revealed that these content factors were related to lower-order facets of personality and to combinations of domains, that is, the ten combinations of the five dimensions of the Five-Factor Model, which are known as personality styles (Costa & McCrae, 1998; Costa & Piedmont, 2003) or the eight personality configurations (types) described by Vollrath and Torgersen (2002).

The facets and styles/types that these content factors are related to suggest that these content factors may also be related to mortality. Inadequacy was associated with higher neuroticism, lower extraversion, and lower conscientiousness (Costa, Busch, et al., 1986), a type labeled “Insecure” and related to engaging in a variety of risky behaviors (Vollrath & Torgersen, 2002). Combinations of high neuroticism and either low extraversion or low conscientiousness, and the combination of low extraversion and low conscientiousness have also been related to incident major depression in older adults (Weiss et al., 2009). Along with being related to a reduced tendency to re-examine one’s values, religious orthodoxy was weakly, but consistently, associated with higher conscientiousness (Costa, Busch, et al.,

1986), which is associated with reduced mortality risk (Kern & Friedman, 2008). Somatic complaints had weak associations with neuroticism and its facets (Costa, Busch, et al., 1986), but like self-rated health (e.g., Idler & Benyamini, 1997; Idler & Kasl, 1991) may be related to mortality. Finally, psychoticism and masculinity versus femininity are not related to the five basic personality trait dimensions in a clear manner (Costa, Busch, et al., 1986). However, there is reason to believe that they are also related to mortality. Psychoticism is made up of items related to risk taking, aggression, and poor mental health, and so is related to high neuroticism, low agreeableness, and low conscientiousness (Costa, Busch, et al., 1986), all traits related to mortality (Deary, et al., 2010; Strickhouser, et al., 2017). Masculinity versus femininity, on the other hand, was most clearly related to the vulnerability facet of neuroticism (Costa, Busch, et al., 1986), and a similar facet was found to be related to lower mortality (Gale et al., 2017).

The second aim was to test whether associations between personality and mortality declined or increased over the follow-up period. This was possible because of the long follow-up time in this sample (45 years) and the fact that just over 90% of the participants had died over this period.

Methods

Participants

Study participants were taken from 2107 middle-aged men who constituted the Western Electric Study cohort (Paul et al., 1963). They included 2080 of 3102 randomly sampled men and 27 men who were part of a pilot group. The 2107 men were employed by the Western Electric Company Hawthorne Works in Chicago, Illinois for at least two years in 1957. To be eligible, they had to, according to the company's records, be 40 to 55 years old in 1958. The ethnicity of 2056 (97.58%) members of the cohort was recorded as "white", the ethnicity of 47 (2.23%) was recorded as "black", the ethnicity of 3 (0.15%) was recorded as

"Mexican", and the ethnicity of 1 (0.05%) member of the cohort was recorded as "Chinese". Additional details on the sampling procedure and participants are available elsewhere (Paul, et al., 1963).

Mortality Risk Factors

All study variables were assessed in 1958 during an initial survey that collected data from a comprehensive physical examination, chest x-ray, 12-lead electrocardiogram, measures of height, weight, skinfold thickness, hemoglobin, serum cholesterol, systolic and diastolic blood pressure, and urinalysis. At this time participants also provided family and medical histories, details of their diet and physical activity, and completed the MMPI. Further details are available elsewhere (Paul, et al., 1963).

Personality variables. Nine factor scales were created to represent the content factors (Costa, et al., 1985). 1. ***Neuroticism*** captures the tendency to worry, and to experience negative affect and depression. 2. ***Cynicism*** refers to a tendency to distrust others and their motives, and to have a pessimistic view of human nature. 3. ***Psychoticism*** is the degree to which individuals have bizarre thoughts, experience paranoid ideation, and hold unusual beliefs. 4. ***Masculinity versus femininity*** contrasts stereotypically masculine interests, activities, and vocations with stereotypically feminine ones. Masculinity versus femininity also contrasts being free of common fears, such as a fear of the dark, with having common fears. 5. ***Extraversion*** captures the tendency to enjoy social gatherings and talking to people, and to being at ease when interacting with others. 6. ***Religious orthodoxy*** is the degree to which individuals observe religious practices, hold fundamentalist beliefs, and follow moral strictures concerning alcohol, swearing, and lying. 7. ***Somatic complaints*** includes reports of fatigue, aches and pains, and other symptoms. 8. ***Inadequacy*** captures a lack of self-confidence, and a tendency to be meek, submissive, and avoid confrontation, and a tendency to have a gloomy, pessimistic outlook (Costa & McCrae, 1998), a risk factor for major

depression (Weiss, et al., 2009). 9. ***Intellectual interests*** describes an enjoyment of reading and a tendency to be intellectually engaged. Absolute correlations between the factor scales ranged from 0.00 to 0.66; the median of the absolute correlations was 0.20 (see Table 1).

Covariates. We adjusted for age and the behavioral and biomedical risk factors used in previous studies of this cohort (Almada, et al., 1991; Shekelle, et al., 1983), those being systolic blood pressure (mm Hg), serum cholesterol (mg/dl), cigarette smoking (number per day), and alcohol consumption (ml/day). In addition, we adjusted for education, BMI (kg/m^2), and heart rate in beats per minute (bpm), which was obtained from an electrocardiogram (see Paul, et al., 1963 for details).

Study Sample

Like previous studies of personality and mortality that used this cohort, we excluded participants who were less than 40 years old ($N = 3$), had a prior history of coronary heart disease ($N = 44$), or had missing data on blood pressure ($N = 2$), serum cholesterol ($N = 1$), or cigarette smoking ($N = 2$) (Almada, et al., 1991; Shekelle, et al., 1983). Like the original study, we also excluded 181 participants who were born outside the United States; the concerns were that culture or language differences might affect their responses to the MMPI (Almada, et al., 1991; Shekelle, et al., 1983). Finally, participants were excluded if they had missing data for 25% or more of the items comprising any of the factor scales: neuroticism ($N = 11$), psychoticism ($N = 10$), masculinity versus femininity ($N = 14$), extraversion ($N = 15$), religious orthodoxy ($N = 19$), somatic complaints ($N = 9$), inadequacy ($N = 13$), cynicism ($N = 14$), and intellectual interests ($N = 16$). After excluding 245 participants who met one or more of these criteria, we were left with 1862 participants. To be consistent with previous studies (Almada, et al., 1991; Shekelle, et al., 1983), we did not exclude nine participants who were 56 years old and one participant who was 58 years old on the day they were

examined. At baseline, participants in the study sample were 40 to 58 years old and their mean age was 47.3 (*SD* = 4.3).

Of the 1862 participants in the study sample, 74 were missing education data. In these cases, we substituted mean years of education (11.3). Compared to participants who had data on education, participants with missing data on this variable were more likely to have died from all causes, $\chi^2(1) = 7.69$, p = .006, but not from coronary heart disease, $\chi^2(1) = 3.37$, $p = .066$; stroke, $\chi^2(1) = 2.37$, $p = .12$; cancer, $\chi^2(1) = 1.82$, $p = .18$; or other causes, $\chi^2(1) = 0.42$, $p = .51$. Participants with missing education data had higher systolic blood pressure, $t_{78.265} = -2.28$, $p = .026$ and a more rapid heart rate, $t_{78.247} = -2.97$, $p = .004$, but did not differ in age, $t_{79.524} = -1.64$, $p = .10$; serum cholesterol level, $t_{79.399} = -0.91$, $p = .37$; BMI, $t_{78.330} = -0.48$, $p = .63$; cigarette smoking, $t_{77.428} = -1.50$, $p = .14$; or alcohol consumption, $t_{75.960} = -1.09$, $p = .28$.

Mortality Surveillance

The National Death Index was used to ascertain vital status up to 2003 (45 years after baseline), date of death, and cause of death for all 2107 Western Electric Study participants. Cause of death was classified as coronary heart disease (ICD8|9 410.0-414.9), cerebrovascular disease (stroke) (ICD8|9 430-438), malignant neoplasms (cancer) (ICD8|9 140-209), and causes other than circulatory diseases, cancer, accidents/homicides/suicides, or injuries (other causes). Because only 47 participants died from accidents, homicides, and suicides, we did not consider non-disease-related mortality in this study.

Of the 1862 study participants, 1693 (90.9%) were recorded as deceased in 2003. In these participants, time to death ranged from 15 days to 46.1 years and age of death ranged from 42.8 to 99.6 years old; mean age of death was 74.7 (*SD* = 10.7). The 169 participants alive in 2003 ranged in age from 85.7 to 99.9 years old; their mean age was 89.4 (*SD* = 3.2).

Analyses

In preliminary analyses, we used Welch's *t*-tests to compare the age, education, and mean levels of behavioral and biomedical risk factors of participants who did and did not die from all causes and from each cause of death. For each mortality outcome, we used a Bonferroni correction to adjust for the familywise error rate expected with the eight comparisons, one for each variable that we compared (critical alpha = .00625).

For our main analyses, we first sought to determine whether the factor scales were associated with risk of death from all causes and from specific causes of death. To these ends we used a series of multivariable proportional hazards (Cox) regressions. In our Cox regressions, all variables, that is, age, education, the biomedical risk factors, and the nine factor scales, were treated as continuous variables and standardized so that they had a mean of 0 and a standard deviation of 1. Thus, hazard ratios indicate the risk associated with one standard deviation of the predictor variable. The response variable in each Cox regression was time to death in days.

The first nine regressions were age-adjusted models in which we tested whether mortality was associated with age and one of the nine factor scales. The second set of nine regressions were age- and risk-factor adjusted models in which we also included education the behavioral and biomedical risk factors, and one factor scale. As in prior studies using this cohort (Almada, et al., 1991; Shekelle, et al., 1983), alcohol consumption was represented by a linear (ml/day) and quadratic $(\text{ml/day})^2$ term to represent the curvilinear association between alcohol consumption and health. The fully-adjusted regression model included age, education, the behavioral and biomedical risk factors, and all nine factor scales, which enabled us to estimate the unique contribution of each content factor to mortality.

Because we tested nine hypotheses (one for each factor scale) in each set of regressions for each mortality outcome, we determined whether these associations prevailed adjusting for the false discovery rate expected with nine significance tests (Benjamini &

Hochberg, 1995). We adjusted for the false discovery rate associated with each model and not all models because we judged that this approach would reduce the type 1 error rate without overly increasing the type 2 error rate.

We then tested whether the association between the factor scales and risk of death varied as a function of follow-up time using a procedure described by T. Therneau, Crowson, and Atkinson (2018). This involved first computing Schoenfeld residuals (1982), which are estimated using all non-censored cases and are used to test the assumption that the hazards associated with the levels of an independent variable are constant over time (proportional). Schoenfeld residuals are defined as the difference between an individual's value on some covariate and the expected value of that covariate (Singer & Willett, 2003, pp. 578-581). The expected value of the covariate is the average of the covariate among everybody at risk for the event at the time that the individual experienced the event weighted by the likelihood that they will experience the event (Singer & Willett, 2003, pp. 578-581). In the present study, for example, each participant's Schoenfeld residual score for extraversion when the event is all-cause mortality would equal the difference between their extraversion score and the mean of extraversion weighted by each at-risk individual's likelihood of dying from any cause.

To conduct these analyses we used the cox.zph function from the survival package (T. M. Therneau, 2015; T. M. Therneau & Grambsch, 2000) in R (R Core Team, 2018) to obtain Schoenfeld residuals for all the variables in our fully-adjusted models for each mortality outcome, and to test whether they were associated with Kaplan-Meier adjusted time to death (T. Therneau, et al., 2018). If residuals showed a significant increase or decrease as a function of time to death, this would indicate that, over the follow-up period, the size of the effect of one or more covariates increased or decreased, respectively. Next, still following T. Therneau, et al. (2018), for any factor scale that had an effect that increased or decreased, we specified a model in which the effects of that factor scale and any other variables that increased or

decreased would be allowed to differ across four time periods. We defined these time periods using three cut-points: 7301 days, 10953 days, and 12780 days to create follow-up periods. These cut-points corresponded to approximately < 20 years, 20 to 29 years, 30 to 34 years, and ≥ 35 years. We chose these periods because the number of deaths in each was roughly equal and so there would be similar statistical power to detect effects within each period (see Table 2). Furthermore, the second period corresponds to life expectancies in 1959 to 1961 (the only period where data are available) for white men aged 40 (31.32 years) to 55 (19.05 years) living in Illinois (National Center for Health Statistics, 1966, pp. 192-193). These periods thus capture early deaths, timely deaths, late deaths, and extremely late deaths, respectively.

Results

Preliminary analyses

Table 3 presents means and standard deviations of age, education, and the behavioral and biomedical risk factors by vital status. Death from all causes was significantly associated with older age, fewer years of education, higher systolic blood pressure, heart rate, and BMI, more cigarette smoking and alcohol consumption, but not with serum cholesterol level. The pattern related to death from coronary heart disease was the same except that higher serum cholesterol but not heart rate was associated with death. Other associations were not significant or did not prevail adjustment for multiple tests.

Survival analyses

Results for the associations of factor scales and all-cause and cause-specific mortality for age-adjusted, age- and risk factor adjusted, and fully-adjusted models are presented in Tables S2, S3, and S4. A summary of these results is presented in Table 4, which also indicates which associations prevailed adjustment for the false discovery rate.

Of the four factor scales related to Five-Factor Model domains, only cynicism was related to mortality and prevailed adjustment for multiple tests. In age-adjusted models, each standard deviation of cynicism was associated with an 11% increase in risk of death from all causes. In fully-adjusted models that adjusted for age, education, the behavioral and biomedical risk factors, and the other factor scales, each standard deviation of cynicism was related to a 10% increase in risk. For cancer death, each standard deviation of cynicism was associated with a 19% increase in risk in the age-adjusted model and a 27% increase in risk in the fully-adjusted model.

Two factor scales related to styles and facets of the Five-Factor Model were also related to risk. In fully-adjusted models each standard deviation of inadequacy was associated with an 11% reduction in all-cause mortality and to a 26% reduction in risk of death from other causes. In the age-adjusted model each standard deviation of religious orthodoxy was associated with a 12% reduction in cancer mortality. These associations also prevailed adjustment for multiple tests.

None of the factor scales were related to risk of death from coronary heart disease or from strokes.

Tests for time-varying coefficients

The findings on cynicism and all-cause mortality were correlated with follow-up time (see Table S5). Across the four periods, the strength of this relationship declined with each standard deviation of cynicism being associated with a ~19, ~11, ~3, and ~1% increase in risk, respectively (see Table S6). Only the relationship over the first 20 years prevailed adjustment for multiple tests.

Death from diseases of the circulatory system

We followed up the null results relating to death from coronary heart disease and death from stroke by testing whether any of the factor scales were associated with death from

diseases of the circulatory system more generally (ICD8|9 390-458.9) and whether any significant associations varied over time. The associations between the factor scales and mortality from diseases of the circulatory system were either non-significant or did not prevail adjustment for multiple tests (see Tables S7, S8, S9). The relationships of the factor scales and death from diseases of the circulatory system did not significantly vary over time (see Table S10).

Discussion

The main results were the identification of MMPI content factors---cynicism, religious orthodoxy, and inadequacy---associated with long-term mortality in middle-aged men. These relationships prevailed correction for the false discovery rate.

Cynicism is a marker of lower levels of the Five-Factor Model domain of agreeableness (Costa, Busch, et al., 1986). Cynicism was associated with greater risk of death from all-causes in a model that adjusted for age and in a fully-adjusted model that included age, education, the behavioral and biomedical risk factors, and the other content factors. Cynicism was not associated with all-cause mortality in a model that adjusted for age, education, and the behavioral and biomedical risk factors, and its association with all-cause mortality waned such that it was only related to greater risk of premature death, that is, deaths occurring in the first 20 years of follow-up. Cynicism was also related to greater risk of death from cancer in the age-adjusted model and in the fully-adjusted model. There was no evidence that the strength of the association between cynicism and cancer-related death varied as a function of follow-up time.

Regarding content factors that were not related to Five-Factor Model domains, in fully-adjusted models, but not in models that adjusted only for age or for age, education, and the behavioral and biomedical risk factors, inadequacy was related to reduced risk of death from all-causes and death from other causes. There was no evidence that either of these

associations varied as a function of follow-up time. Likewise, religious orthodoxy was significantly associated with reduced risk of cancer death in the age-adjusted model, but the association was not significant after adjusting for education and the behavioral and biomedical risk factors, or in the fully-adjusted model. There was no evidence that the association between religious orthodoxy and cancer mortality varied over follow-up time.

The present finding of an association between cynicism and all-cause mortality is not consistent with one large study. In that study, Jokela, et al. (2013) found no consistent relationship between agreeableness and mortality in just over 76,000 men and women from 7 pooled datasets who had been followed for a mean of about 6 years and whose mean age was around 51 years. The association between cynicism and all-cause mortality is, however, consistent with several studies that report that disagreeable, hostile, cynical, and antagonistic people are at greater risk of death from all causes (Almada, et al., 1991; Costa, et al., 2014; Shekelle et al., 1981; Tindle, et al., 2009; Weiss & Costa, 2005), including one that found such a relationship across 15 studies (Graham, et al., 2017). A second-order meta-analysis of the personality-health literature also affirmed the relationship between low agreeableness and poorer health outcomes, including mortality (Strickhouser, et al., 2017).

The present study suggests that some of the variability in the strength of the relationship between personality traits related to agreeableness and all-cause mortality may be attributable to two factors. First, cynicism was only associated with premature death from all-causes, and the participants were middle-aged in 1958 when the study began. As such, there may be a limited time window during which traits related to low agreeableness are related to all-cause mortality. Second, as noted elsewhere (Weiss & Costa, 2014), many of the scales used to measure agreeableness in the samples analyzed by Jokela, et al. (2013) are overly narrow and/or have poor discriminant validity (see, e.g., Lachman, 2005). The scales used in these studies may therefore not capture aspects of agreeableness related to cynicism,

such as trust (Costa & McCrae, 1995) and hostility (Costa, Zonderman, McCrae, & Williams, 1986), while at the same time capturing aspects of extraversion, such as interpersonal warmth (Costa & McCrae, 1995). Further studies that examine broad measures of agreeableness and related traits and that model change in the association between these measures and all-cause mortality will go some way to testing whether one or both of these factors explains the differences across these studies.

The relationship between cynicism and risk of death from cancer was quite strong. In fact, the risk conferred by a standard deviation in cynicism (answering true to around 7 or 8 of the 36 cynicism items) approached the risk conferred by a standard deviation in cigarette smoking (smoking between 11 and 12 cigarettes a day). The relationship between cynicism and cancer death was also fairly robust as the relationship prevailed adjustment for all of the other variables and correction for the false-discovery rate. These findings are surprising given the paucity of findings of an association between personality and cancer death in the literature. However, two earlier studies of this cohort reported a possible link between agreeableness-like traits and cancer mortality (Almada, et al., 1991; Shekelle, et al., 1983). Moreover, data on nearly 100,000 post-menopausal women revealed an association between hostility and cancer mortality (Tindle, et al., 2009) and a cohort study of men and women employed by France's national gas and power company also found an association between hostility and incidence of smoking-related cancers (Lemogne et al., 2013).

On the other hand, Jokela, Batty, et al. (2014) found no significant association between agreeableness and both cancer incidence and cancer mortality in their analyses of pooled cohort studies. Two factors may explain why the findings from the study by Jokela et al. differed from studies that did find an association. The first possibility is the above-mentioned problem with the agreeableness measures used in many of the cohorts investigated by Jokela, Batty, et al. (2014). The second is that this difference is a cohort effect. Compared

to these other cohorts, at midlife, and throughout most of their lives, the participants in the Western Electric Study lived in a time when smoking was more socially acceptable and more prevalent (Cummings & Proctor, 2014; Wang et al., 2018). Consequently, traits related to the avoidance of smoking may have had a more pronounced effect on differences in cancer-related mortality in the Western Electric cohort. To test the latter explanation would require first investigating whether cynicism, or closely related traits, such as low agreeableness, is primarily related to smoking-related cancers and comparing the relationship between these sorts of traits and cancer deaths in different age cohorts.

Another surprising finding was the lack of an associations between cynicism and death due to cardiovascular diseases. This finding is not consistent with prior studies of the Western Electric cohort (Almada, et al., 1991; Shekelle, et al., 1983). These findings are, however, consistent with those from the study of post-menopausal women, which found no association between cynicism and death from coronary heart disease or death from stroke (Tindle, et al., 2009) and a study of three cohorts, which found no relationship between agreeableness and cardiovascular disease death or stroke (Jokela, Pulkki-Raback, et al., 2014). It is also consistent with a lack of an association between agreeableness and self-reported cardiovascular disease (Benet-Martínez & John, 1998; Soto, 2019). There was no evidence in our study to suggest that the association between cynicism and deaths by cardiovascular diseases varied over follow-up time.

One possible explanation for why we did not find an association between cynicism and death from coronary heart disease is that, compared to the previous study (Almada, et al., 1991), this study was conservative: we treated age as a continuous variable, included education and additional biomedical risk factors, and adjusted for the false discovery rate. We also included all of the content factors in our final model. Evidence that differences between our study and the prior study played a role include the fact that, had we not adjusted for the

false-discovery rate, cynicism would have been statistically significant in the model that adjusted only for age and non-significant in models that included other covariates. The relationships between low agreeableness and cardiovascular diseases and death in this sample may therefore have been mediated by health behaviors and biomedical risk factors.

Jokela, Pulkki-Raback, et al. (2014) found a large association between higher extraversion and death from stroke. However, our study, like two previous studies (Nakaya, et al., 2005; Shipley, et al., 2007), despite having more power to detect such an association, did not find an association between extraversion, let alone any other factor scale, and stroke. The most likely explanation for this discrepancy is that the association found between extraversion and stroke death in this prior study was a false positive. This possibility is consistent with the fact that the association in that study appeared to be driven by a single cohort that had 8 cases of death by stroke in just under 4000 participants (see Figure 2 in Jokela, Pulkki-Raback, et al., 2014).

Taken together, our findings relating to cynicism suggest that the association between this content factor and all-cause mortality is largely attributable to cancer. The diminishing strength over time of the association between cynicism and all-cause mortality thus may reflect the fact that, in later periods, the proportion of participants dying from causes other than cancer or from cancers that are only weakly related to cynicism, increases. Alternatively, it may reflect advances in detecting and treating illnesses, such as cancer, and a public that is better informed about behavioral risk factors.

Cynicism may be associated with cancer death because people who are lower in agreeableness smoke more (Terracciano & Costa, 2004). Although the relationship was still significant when we adjusted for smoking, there was an association between higher heart rate and cancer mortality, suggesting the possibility of residual confounding. Another possible explanation for the association between cynicism and cancer lies in the fact that lower

agreeableness is associated with higher levels of interleukin-6 (Marsland, Prather, Petersen, Cohen, & Manuck, 2008; Sjögren, Leanderson, Kristenson, & Ernerudh, 2006; Sutin, et al., 2009). It is also possible that cynicism is related to cancer death because people high on cynicism have "distrusting and disparaging attitudes towards the motives of others" (Costa, et al., 1985, p. 929) and so may reject advice, recommendations, and treatments that may reduce the risk of developing cancer or increase the likelihood of surviving cancer.

Turning to the content factors that were related to risk but that were not related to the Five-Factor Model domains, the association of inadequacy and reduced risk was puzzling. Individuals high in inadequacy are characterized by "shyness and feelings of incompetence when facing adversity." (Costa, et al., 1985, p. 929). Why are these individuals apparently at reduced risk of all-cause mortality and death from other causes? A previous study found that a similar trait (submissiveness) was associated with reduced risk of myocardial infarction (Whiteman, Deary, Lee, & Fowkes, 1997). However, inadequacy was not associated in the present study with coronary death, stroke death, or circulatory deaths. A previous study of university students by (Vollrath & Torgersen, 2002) found that they could classify participants as belonging to one of eight personality types. One of these types was described as "insecure" and participants with this personality type were low in extraversion, high in neuroticism, and low in conscientiousness (Vollrath & Torgersen, 2002). This personality profile of this group therefore was consistent with their likely being high in inadequacy (see Table S1). This group of participants was more likely to smoke, use illicit drugs, and drive while drunk (Vollrath & Torgersen, 2002), but was less likely to binge drink and to have new sexual partners (Vollrath & Torgersen, 2008). These findings suggest that this group would be at greater risk of dying from several causes; however, we found the opposite. In their studies, Vollrath and Torgersen did not adjust for the effects of other personality variables. It may be that individuals who are timid and self-conscious, after controlling for the other

personality factors, may be less prone to exposing themselves to cumulative risk factors that shorten their lives.

Together with the findings relating to cynicism, the results relating to inadequacy illustrate the dynamics of the links between personality and mortality in this sample. Premature deaths, that is, those occurring less than 20 years after baseline, reflect the relationship between high cynicism and cancer deaths and the relationship between low inadequacy and death from non-external causes other than circulatory diseases or cancers. Later deaths, including those within the normal range and those of long-lived participants, reflect the association between low inadequacy and death from other causes.

It is possible that, by virtue of their possible association with personality, some of the associations between mortality and the biomedical and behavioral risk factors may reflect indirect effects of personality. This possibility is supported by our finding that higher scores on religious orthodoxy, which meant endorsing items such as "I believe that a person should never taste an alcohol drink.", were associated with a reduced risk of cancer death in models that did not adjust for education and the behavioral and biomedical risk factors. To explore this possibility, we examined the association between religious orthodoxy and tobacco use, the leading preventable cause of cancer (American Cancer Society, 2019), in the present sample. We therefore first compared the religious orthodoxy scores of non-smokers (n = 807) and smokers (n = 1055) by means of a Welch's two-sample t-test. We then, for all 1862 participants, and for the 1055 smokers, obtained correlations between religious orthodoxy and number of cigarettes smoked per day. The standardized religious orthodoxy score of non-smokers (mean = 0.13) was significantly higher than that of smokers (mean = -0.10), $t_{1679.80}$ = 4.77, $p < .001$. The correlation between religious orthodoxy and smoking was significant in the total sample (r = -0.17, 95% CI = [-0.21, -0.12], $p < .001$) and among participants who smoked (r = -0.19, 95% CI = [-0.24, -0.13], $p < .001$). The results from these analyses

suggest that religious orthodoxy was related to reduced cancer mortality because higher scores on this factor scale were associated with a greater likelihood of not smoking or of smoking less.

In our study, there were three cases where one or more variables may have been acting as a suppressor (MacKinnon, Krull, & Lockwood, 2000; Tzelgov & Henrik, 1991). First, the size of the relationship between cynicism and cancer death was reduced slightly and only nominally significant when we included education and the biomedical risk factors; the size of the relationship then displayed a large increase when the other content factors were included in the model. This seems to indicate that the association between cynicism and cancer death is restricted to the variance that cynicism shares with low agreeableness and not neuroticism, psychoticism, or inadequacy. The other two cases concern inadequacy. In particular, the association between inadequacy and all-cause mortality and death from other causes was larger and only significant in the fully-adjusted models. Thus, these associations are confined to inadequacy variance that is not shared with neuroticism, cynicism, psychoticism, somatic complaints, and possibly one or more covariates. Reports of suppressor effects in the personality and mortality literature are not unknown. For instance, studies have found that including self-rated health and similar variables in a model can reverse the association between neuroticism and health risks, possibly because including self-rated health adjusts for the health-harming effects of neuroticism, leaving protective effects (Gale, et al., 2017; Korten et al., 1999; Ploubidis & Grundy, 2009; Weiss, Gale, Batty, & Deary, 2013; Weiss et al., 2019). These findings and those of the present study suggest that isolating the unique variance related to personality traits, either statistically or in our personality measures, will improve our understanding of personality-mortality relationships.

This study was not without limitations. For one, the sample was comprised almost entirely of white men. It is therefore unclear to what extent these findings will generalize to

more diverse samples of men and women. That said, the findings relating to cynicism in this study are mostly in agreement with studies that use more diverse samples (Graham, et al., 2017; Tindle, et al., 2009). Because it has not been examined as a mortality risk factor before, it is unclear whether the results related to inadequacy would replicate in more diverse samples. A second limitation is that the MMPI's component structure was derived prior to it being easy to conduct parallel analysis and similar analyses, and so the identification of the number of components was based on inspections of scree plots and the interpretability of the components (Costa, et al., 1985). A third limitation is that the components were scored by means of creating unit-weighted sum scores (Gorsuch, 1983), and so were often correlated. A fourth limitation concerns the absence of conscientiousness, which has strong associations with health outcomes, including mortality (Deary, et al., 2010), but was not present in or only marginally represented in the MMPI (Costa, Busch, et al., 1986). The fifth limitation is that our approach to reducing the number of type 1 errors may have been a bit lenient, particularly as the different causes of death were not, strictly speaking, independent outcomes. However, the nominal *p*-values for our main findings were around or less than .001. As such, it is unlikely that our main findings are false positives.

The present study also had several strengths. The cohort was well-defined, and the lengthy follow-up time meant that we had adequate power to detect effects and to model changes in the relationship between the factor scales and mortality. In addition, the data allowed us to adjust for major biomedical and behavioral risk factors, including cigarette smoking, alcohol consumption, serum cholesterol, and heart rate. Finally, the nature of the factor scales enabled us to examine the roles of some personality facets and styles, which would not be possible with many other personality instruments.

Conclusion

We found replicated and novel associations between personality traits and mortality outcomes. We also identified life-span developmental and methodological factors that might affect these associations. These factors include possible period and cohort effects as well as factors pertaining to how personality is measured. A better understanding of the personality-mortality relationship requires broad measures of personality, well-defined cohorts, and sufficiently lengthy follow-up periods.

References

Almada, S. J., Zonderman, A. B., Shekelle, R. B., Dyer, A. R., Daviglus, M. L., Costa, P. T., Jr., & Stamler, J. (1991). Neuroticism and cynicism and risk of death in middle-aged men: The Western Electric Study. *Psychosomatic Medicine, 53*, 165-175. http://dx.doi.org/10.1097/00006842-199103000-00006

American Cancer Society. (2019). *Cancer facts & figures*. Atlanta, GA: American Cancer Society.

Anusic, I., & Schimmack, U. (2016). Stability and change of personality traits, self-esteem, and well-being: Introducing the meta-analytic stability and change model of retest correlations. *Journal of Personality and Social Psychology, 110*, 766-781. http://dx.doi.org/10.1037/pspp0000066

Barefoot, J., Dodge, K. A., Peterson, B. L., Dahlstrom, W. G., & Williams, R. B. (1989). The Cook-Medley Hostility Scale: Item content and ability to predict survival. *Psychosomatic Medicine, 51*, 46-57. http://dx.doi.org/10.1097/00006842-198901000-00005

Benet-Martínez, V., & John, O. P. (1998). Los Cinco Grandes across cultures and ethnic groups: Multitrait multimethod analysis of the Big Five in Spanish and English. *Journal of Personality and Social Psychology, 75*, 729–750. http://dx.doi.org/10.1037/0022-3514.75.3.729

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological), 57*, 289-300. http://dx.doi.org/10.2307/2346101

Brummett, B. H., Siegler, I. C., Day, R. S., & Costa, P. T., Jr. (2008). Personality as a predictor of dietary quality in spouses during midlife. *Behavioral Medicine, 34*, 5-10. http://dx.doi.org/10.3200/BMED.34.1.5-10

Cook, W., & Medley, D. (1954). Proposed hostility and pharasaic-virtue scales for the MMPI. *Journal of Applied Psychology, 38*, 414-418. http://dx.doi.org/10.1037/h0060667

Costa, P. T., Jr., Busch, C. M., Zonderman, A. B., & McCrae, R. R. (1986). Correlations of MMPI factor scales with measures of the Five Factor Model of personality. *Journal of Personality Assessment, 50*, 640-650. http://dx.doi.org/10.1207/s15327752jpa5004_10

Costa, P. T., Jr., & McCrae, R. R. (1985). *The NEO Personality Inventory manual*. Odessa, FL: Psychological Assessment Resources.

Costa, P. T., Jr., & McCrae, R. R. (1995). Domains and facets: Hierarchical personality assessment using the Revised NEO Personality Inventory. *Journal of Personality Assessment, 64*, 21-50. http://dx.doi.org/10.1207/s15327752jpa6401_2

Costa, P. T., Jr., & McCrae, R. R. (1998). *Manual supplement for the NEO-4*. Odessa, FL: Psychological Assessment Resources.

Costa, P. T., Jr., McCrae, R. R., & Löckenhoff, C. E. (2019). Personality across the life span. *Annual Review of Psychology, 70*, 423-448. http://dx.doi.org/10.1146/annurev-psych-010418-103244

Costa, P. T., Jr., & Piedmont, R. L. (2003). Interpretation of the NEO personality inventory profiles of Madeline G. Self, partner and an integrated perspective. In J. S. Wiggins (Ed.), *Paradigms of personality assessment*. New York, NY: Guilford Press.

Costa, P. T., Jr., Weiss, A., Duberstein, P. R., Friedman, B., & Siegler, I. C. (2014). Personality facets and all-cause mortality among Medicare patients aged 66 to 102 years: A follow-on study of Weiss and Costa (2005). *Psychosomatic Medicine, 76*, 370-378. http://dx.doi.org/10.1097/PSY.0000000000000070

Costa, P. T., Jr., Zonderman, A. B., McCrae, R. R., & Williams, R. B., Jr. (1985). Content and comprehensiveness in the MMPI: An item factor analysis in a normal adult

sample. *Journal of Personality and Social Psychology, 48*, 925-933. http://dx.doi.org/10.1037/0022-3514.48.4.925

Costa, P. T., Jr., Zonderman, A. B., McCrae, R. R., & Williams, R. B., Jr. (1986). Cynicism and paranoid alienation in the Cook and Medley HO Scale. *Psychosomatic Medicine, 48*, 283-285. http://dx.doi.org/10.1097/00006842-198603000-00014

Cummings, K. M., & Proctor, R. N. (2014). The changing public image of smoking in the United States: 1964-2014. *Cancer Epidemiology, Biomarkers & Prevention, 23*, 32-36. http://dx.doi.org/10.1158/1055-9965.EPI-13-0798

Deary, I. J., Weiss, A., & Batty, G. D. (2010). Intelligence and personality as predictors of illness and death: How researchers in differential psychology and chronic disease epidemiology are collaborating to understand and address health inequalities. *Psychological Science in the Public Interest, 11*, 53-79. http://dx.doi.org/10.1177/1529100610387081

Eysenck, S. B. G., & Eysenck, H. J. (1964). An improved short questionnaire for the measurement of extraversion and neuroticism. *Life Sciences, 3*, 1103-1109. http://dx.doi.org/10.1016/0024-3205(64)90125-0

Eysenck, S. B. G., Eysenck, H. J., & Barrett, P. (1985). A revised version of the psychoticism scale. *Personality and Individual Differences, 6*, 21-29. http://dx.doi.org/10.1016/0191-8869(85)90026-1

Ferguson, E., & Bibby, P. A. (2011). Openness to experience and all-cause mortality: A meta-analysis and $r_{equivalent}$ from risk ratios and odds ratios. *British Journal of Health Psychology, 17*, 85-102. http://dx.doi.org/10.1111/j.2044-8287.2011.02055.x

Friedman, H. S. (2019). Neuroticism and health as individuals age. *Personality Disorders: Theory, Research, and Treatment, 10*, 25-32. http://dx.doi.org/10.1037/per0000274

Gale, C. R., Čukić, I., Batty, G. D., McIntosh, A. M., Weiss, A., & Deary, I. J. (2017). When is higher neuroticism protective against death? Findings from UK Biobank. *Psychological Science, 28*, 1345-1357. http://dx.doi.org/10.1177/0956797617709813

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Graham, E. K., Rutsohn, J. P., Turiano, N. A., Bendayan, R., Batterham, P. J., Gerstorf, D., . . . Mroczek, D. K. (2017). Personality predicts mortality risk: An integrative data analysis of 15 international longitudinal studies. *Journal of Research in Personality, 70*, 174-186. http://dx.doi.org/doi.org/10.1016/j.jrp.2017.07.005

Hathaway, S. R., & McKinley, J. C. (1943). *The Minnesota Multiphasic Personality Inventory*. Minneapolis, MN: University of Minnesota Press.

Hill, W. D., Weiss, A., Liewald, D., Davies, G., Porteous, D. J., Hayward, C., . . . Deary, I. J. (2019). Genetic contributions to two special factors of neuroticism are associated with affluence, higher intelligence, better health, and longer life. *Molecular Psychiatry*. http://dx.doi.org/10.1038/s41380-019-0387-3

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior, 38*, 21-37. http://dx.doi.org/10.2307/2955359

Idler, E. L., & Kasl, S. (1991). Health perceptions and survival: Do global evaluations of health status really predict mortality? *Journal of Gerontology, 46*, S55-S65. http://dx.doi.org/10.1093/geronj/46.2.S55

Jokela, M., Batty, G. D., Hintsa, T., Elovainio, M., Hakulinen, C., & Kivimäki, M. (2014). Is personality associated with cancer incidence and mortality? An individual-participant meta-analysis of 2156 incident cancer cases among 42 843 men and women. *British Journal of Cancer, 110*, 1820-1824. http://dx.doi.org/10.1038/bjc.2014.58

Jokela, M., Batty, G. D., Nyberg, S. T., Virtanen, M., Nabi, H., Singh-Manoux, A., & Kivimäki, M. (2013). Personality and all-cause mortality: Individual-participant meta-analysis of 3,947 deaths in 76,150 adults. *American Journal of Epidemiology, 178*, 667-675. http://dx.doi.org/10.1093/aje/kwt170

Jokela, M., Pulkki-Raback, L., Elovainio, M., & Kivimaki, M. (2014). Personality traits as risk factors for stroke and coronary heart disease mortality: pooled analysis of three cohort studies. *Journal of Behavioral Medicine, 37*, 881-889. http://dx.doi.org/10.1007/s10865-013-9548-z

Jonassaint, C. R., Boyle, S. H., Williams, R. B., Mark, D. B., Siegler, I. C., & Barefoot, J. C. (2007). Facets of openness predict mortality in patients with cardiac disease. *Psychosomatic Medicine, 69*, 319-322. http://dx.doi.org/10.1097/PSY.0b013e318052e27d

Kern, M. L., & Friedman, H. S. (2008). Do conscientious individuals live longer? A quantitative review. *Health Psychology, 27*, 505-512. http://dx.doi.org/10.1037/0278-6133.27.5.505

Korten, A. E., Jorm, A. F., Jiao, Z., Letenneur, L., Jacomb, P. A., Henderson, A. S., . . . Rodgers, B. (1999). Health, cognitive, and psychosocial factors as predictors of mortality in an elderly community sample. *Journal of Epidemiology and Community Health, 53*, 83-88. http://dx.doi.org/10.1136/jech.53.2.83

Lachman, M. E. (2005). Addendum for MIDI personality scales: MIDUS II version. Walthman, MA: Brandeis University.

Lemogne, C., Consoli, S. M., Geoffroy-Perez, B., Coeuret-Pellicer, M., Nabi, H., Melchior, M., . . . Cordier, S. (2013). Personality and the risk of cancer: a 16-year follow-up study of the GAZEL cohort. *Psychosomatic medicine, 75*, 262-271. http://dx.doi.org/10.1097/PSY.0b013e31828b5366

Lunn, T. E., Nowson, C. A., Worsley, A., & Torres, S. J. (2014). Does personality affect dietary intake? *Nutrition, 30*, 403-409. http://dx.doi.org/10.1016/j.nut.2013.08.012

MacKinnon, D. P., Krull, J. L., & Lockwood, C. M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention Science, 1*, 173-181. http://dx.doi.org/10.1023/A:1026595011371

Marshall, G. N., Wortman, C. B., Kusulas, J. W., Hervig, L. K., & Vickers, R. R., Jr. (1992). Distinguishing optimism from pessimism: Relations to fundamental dimensions of mood and personality. *Journal of Personality and Social Psychology, 62*, 1067-1074. http://dx.doi.org/10.1037/0022-3514.62.6.1067

Marsland, A. L., Prather, A. A., Petersen, K. L., Cohen, S., & Manuck, S. B. (2008). Antagonistic characteristics are positively associated with inflammatory markers independently of trait negative emotionality. *Brain Behavior and Immunity, 22*, 753-761. http://dx.doi.org/10.1016/j.bbi.2007.11.008

McCrae, R. R., & Costa, P. T., Jr. (1985). Comparison of EPI and psychoticism scales with measures of the five-factor model of personality. *Personality and Individual Differences, 6*, 587-597. http://dx.doi.org/10.1016/0191-8869(85)90008-X

Mosing, M. A., Medland, S. E., McRae, A., Landers, J. G., Wright, M. J., & Martin, N. G. (2012). Genetic influences on lifespan and its relationship to personality: A 16-year follow-up study of a sample of aging twins. *Psychosomatic Medicine, 74*, 16-22. http://dx.doi.org/10.1097/PSY.0b013e3182385784

Mõttus, R., Realo, A., Allik, J., Deary, I. J., Esko, T., & Metspalu, A. (2012). Personality traits and eating habits in a large sample of Estonians. *Health Psychology, 31*, 416-423. http://dx.doi.org/doi: 10.1037/a0027041

Nakaya, N., Tsubono, Y., Hosokawa, T., Hozawa, A., Kuriyama, S., Fukudo, S., & Tsuji, I. (2005). Personality and mortality from ischemic heart disease and stroke. *Clinical and Experimental Hypertension, 27*, 297-305. http://dx.doi.org/10.1081/CEH-48930

National Center for Health Statistics. (1966). *State life tables: 1959-61* (Vol. 2). Washington, D.C.: Public Health Service.

Paul, O., Lepper, M. H., Phelan, W. H., Dupertuis, C. W., MacMillan, A., McKean, H., & Park, H. (1963). A longitudinal study of coronary heart disease. *Circulation, 28*, 20-31. http://dx.doi.org/10.1161/01.CIR.28.1.20

Ploubidis, G. B., & Grundy, E. (2009). Personality and all cause mortality: Evidence for indirect links. *Personality and Individual Differences, 47*, 203-208. http://dx.doi.org/10.1016/j.paid.2009.02.022

R Core Team. (2018). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from https://www.R-project.org/

Roberts, B. W., & DelVecchio, W. F. (2000). The rank-order consistency of personality traits from childhood to old age: A quantitative review of longitudinal studies. *Psychological Bulletin, 126*, 3-25. http://dx.doi.org/10.1037/0033-2909.126.1.3

Roberts, B. W., Kuncel, N. R., Shiner, R., Caspi, A., & Goldberg, L. R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives on Psychological Science, 2*, 313-345. http://dx.doi.org/10.1111/j.1745-6916.2007.00047.x

Roberts, B. W., Walton, K. E., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin, 132*, 1-25. http://dx.doi.org/10.1037/0033-2909.132.1.1

Roh, S.-J., Kim, H.-N., Shim, U., Kim, B.-H., Kim, S.-J., Chung, H. W., . . . Kim, H.-L. (2014). Association between blood lipid levels and personality traits in young Korean women. *PLoS ONE, 9*, e108406. http://dx.doi.org/10.1371/journal.pone.0108406

Schoenfeld, D. (1982). Partial residuals for the proportional hazards regression model. *Biometrika, 69*, 239-241. http://dx.doi.org/10.2307/2335876

Sharpe, J. P., Martin, N. R., & Roth, K. A. (2011). Optimism and the Big Five factors of personality: Beyond Neuroticism and Extraversion. *Personality and Individual Differences, 51*, 946-951. http://dx.doi.org/10.1016/j.paid.2011.07.033

Shekelle, R. B., Gale, M., Ostfeld, A. M., & Paul, O. (1983). Hostility, risk of coronary heart-disease, and mortality. *Psychosomatic Medicine, 45*, 109-114. http://dx.doi.org/10.1097/00006842-198305000-00003

Shekelle, R. B., Raynor, W. J., Ostfeld, A. M., Garron, D. C., Bieliauskas, L. A., Liu, S. C., . . . Oglesby, P. (1981). Psychological depression and 17-year risk of death from cancer. *Psychosomatic Medicine, 43*, 117-125. http://dx.doi.org/10.1097/00006842-198104000-00003

Shipley, B. A., Weiss, A., Der, G., Taylor, M. D., & Deary, I. J. (2007). Neuroticism, extraversion, and mortality in the UK Health and Lifestyle Survey: 21-year prospective cohort study. *Psychosomatic Medicine, 69*, 923-931. http://dx.doi.org/10.1097/psy.0b013e31815abf83

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: modeling change and event occurrence*. New York, NY: Oxford University Press.

Sjögren, E., Leanderson, P., Kristenson, A., & Ernerudh, J. (2006). Interleukin-6 levels in relation to psychosocial factors: Studies on serum, saliva, and in vitro production by blood mononuclear cells. *Brain Behavior and Immunity, 20*, 270-278. http://dx.doi.org/10.1016/j.bbi.2005.08.001

Soto, C. J. (2019). How replicable are links between personality traits and consequential life outcomes? The life outcomes of personality replication project. *Psychological Science, 30*, 711-727. http://dx.doi.org/10.1177/0956797619831612

Stephan, Y., Sutin, A. R., Luchetti, M., & Terracciano, A. (2016). Allostatic load and personality: A 4-year longitudinal study. *Psychosomatic Medicine, 78*, 302-310. http://dx.doi.org/10.1097/PSY.0000000000000281

Strickhouser, J. E., Zell, E., & Krizan, Z. (2017). Does personality predict health and well-being? A metasynthesis. *Health Psychology, 36*, 797-810. http://dx.doi.org/10.1037/hea0000475

Sutin, A. R., Ferrucci, L., Zonderman, A. B., & Terracciano, A. (2011). Personality and obesity across the adult life span. *Journal of Personality and Social Psychology, 101*, 579-592. http://dx.doi.org/10.1037/a0024286

Sutin, A. R., Terracciano, A., Deiana, B., Naitza, S., Ferrucci, L., Uda, M., . . . Costa, P. T., Jr. (2009). High neuroticism and low conscientiousness are associated with interleukin-6. *Psychological Medicine, 40*, 1485-1493. http://dx.doi.org/10.1017/S0033291709992029

Sutin, A. R., Terracciano, A., Deiana, B., Uda, M., Schlessinger, D., Lakatta, E. G., & Costa, P. T., Jr. (2010). Cholesterol, triglycerides, and the Five-Factor Model of personality. *Biological Psychology, 84*, 186-191. http://dx.doi.org/10.1016/j.biopsycho.2010.01.012

Terracciano, A., & Costa, P. T., Jr. (2004). Smoking and the Five-Factor Model of personality. *Addiction, 99*, 472-481. http://dx.doi.org/10.1111/j.1360-0443.2004.00687.x

Therneau, T., Crowson, C., & Atkinson, E. (2018). *Using time dependent covariates and time dependent coefficients in the Cox model*. Retrieved from https://cran.r-project.org/web/packages/survival/vignettes/timedep.pdf

Therneau, T. M. (2015). A package for survival analysis in S (Version 2.38). Retrieved from https://CRAN.R-project.org/package=survival

Therneau, T. M., & Grambsch, P. M. (2000). *Modeling survival data: Extending the Cox model*. New York: Springer.

Tindle, H. A., Chang, Y.-F., Kuller, L. H., Manson, J. E., Robinson, J. G., Miagros, C. R., . . . Matthews, K. A. (2009). Optimism, cynical hostility, and incident coronary heart disease and mortality in the Women's Health Initiative. *Circulation, 120*, 656-662. http://dx.doi.org/10.1161/CIRCULATIONAHA.108.827642

Turiano, N. A., Mroczek, D. K., Moynihan, J., & Chapman, B. P. (2013). Big 5 personality traits and interleukin-6: Evidence for "healthy Neuroticism" in a US population sample. *Brain, Behavior, and Immunity, 28*, 83-89. http://dx.doi.org/10.1016/j.bbi.2012.10.020

Tzelgov, J., & Henrik, A. (1991). Suppression situations in psychological research: Definitions, implications, and applications. *Psychological Bulletin, 109*, 524-536. http://dx.doi.org/10.1037/0033-2909.109.3.524

Vollrath, M. E., & Torgersen, S. (2002). Who takes health risks? A probe into eight personality types. *Personality and Individual Differences, 32*, 1185-1197. http://dx.doi.org/10.1016/S0191-8869(01)00080-0

Vollrath, M. E., & Torgersen, S. (2008). Personality types and risky health behaviors in Norwegian students. *Scandinavian Journal of Psychology, 49*, 287-292. http://dx.doi.org/10.1111/j.1467-9450.2008.00631.x

Wang, T. W., Asman, K., Gentzke, A. S., Cullen, K. A., Holder-Hayes, E., Reyes-Guzman, C., . . . King, B. A. (2018). Tobacco Product Use Among Adults — United States, 2017. *Morbidity and Mortality Weekly Report (MMWR), 67*. http://dx.doi.org/10.15585/mmwr.mm6744a2

Weiss, A., & Costa, P. T., Jr. (2005). Domain and facet personality predictors of all-cause mortality among Medicare patients aged 65 to 100. *Psychosomatic Medicine, 67*, 724-733. http://dx.doi.org/10.1097/01.psy.0000181272.58103.18

Weiss, A., & Costa, P. T., Jr. (2014). Re: "Personality and all-cause mortality: Individual-participant meta-analysis of 3,947 deaths in 76,150 adults". *American Journal of Epidemiology, 179*, 791-792. http://dx.doi.org/10.1093/aje/kwt300

Weiss, A., Gale, C. R., Batty, G. D., & Deary, I. J. (2013). A questionnaire-wide association study of personality and mortality: The Vietnam Experience Study. *Journal of Psychosomatic Research*. http://dx.doi.org/10.1016/j.jpsychores.2013.02.010

Weiss, A., Gale, C. R., Čukić, I., Batty, G. D., McIntosh, A. M., & Deary, I. J. (2019). Conditioning on a collider may or may not explain the relationship between lower neuroticism and premature mortality in the study by Gale et al. (2017): a reply to Richardson, Davey Smith, and Munafò (2019). *Psychological Science, 30*, 633-638. http://dx.doi.org/10.1177/0956797619833325

Weiss, A., Sutin, A. R., Duberstein, P. R., Friedman, B., Bagby, R. M., & Costa P.T., J. (2009). The personality domains and styles of the Five-Factor Model predict incident depression in Medicare recipients aged 65 to 100. *American Journal of Geriatric Psychiatry, 17*, 591-601. http://dx.doi.org/10.1097/JGP.0b013e31819d859d

Whiteman, M., Deary, I. J., Lee, A., & Fowkes, F. G. R. (1997). Submissiveness and risk of myocardial infarction: Edinburgh Artery Study. *Lancet, 350*, 541-545. http://dx.doi.org/10.1016/S0140-6736(96)03141-8

Table 1

Pearson Product-Moment Correlations Among Factor Scales

	N	P	MF	E	RO	SC	I	C	II
N. Neuroticism	1.00								
P. Psychoticism	0.60	1.00							
MF. Masculinity vs. femininity	-0.33	-0.35	1.00						
E. Extraversion	0.02	-0.06	-0.06	1.00					
RO. Religious orthodoxy	0.00	0.08	-0.16	0.02	1.00				
SC. Somatic complaints	0.58	0.46	-0.25	-0.07	-0.01	1.00			
I. Inadequacy	0.66	0.52	-0.27	-0.26	0.02	0.44	1.00		
C. Cynicism	0.60	0.54	-0.26	0.19	0.10	0.28	0.41	1.00	
II. Intellectual interests	-0.07	-0.09	-0.07	0.31	0.11	-0.13	-0.21	-0.01	1.00

Note. The correlations reported above are similar to the correlations among the factor scales in Costa, et al. (1985). The correlation between Fisher-transformed correlations of this study and those of the previous study was 0.95.

Table 2

Number at Risk, Number of Censored Cases, and Number of Events for Deaths by All-Causes, Coronary Heart Disease, Stroke, Cancer, Other Causes, and Diseases of the Circulatory System for Each Period.

	At risk	Censored[a]	Events
All-causes			
< 20 years	1862	0	446
20 to 29 years	1416	0	504
30 to 34 years	912	0	263
≥ 35 years	649	169	480
Coronary heart disease			
< 20 years	1862	225	221
20 to 29 years	1416	317	187
30 to 34 years	912	168	95
≥ 35 years	649	507	142
Stroke			
< 20 years	1862	419	27
20 to 29 years	1416	462	42
30 to 34 years	912	239	24
≥ 35 years	649	607	42
Cancer			
< 20 years	1862	332	114
20 to 29 years	1416	362	142
30 to 34 years	912	208	55
≥ 35 years	649	573	76
Other causes			
< 20 years	1862	407	39
20 to 29 years	1416	431	73
30 to 34 years	912	200	63
≥ 35 years	649	488	161
Diseases of the circulatory system			
< 20 years	1862	175	271
20 to 29 years	1416	229	275
30 to 34 years	912	120	143
≥ 35 years	649	415	234

Note. [a] For specific causes of death, censored cases include participants who died of another cause.

Table 3

Means and Standard Deviations for Baseline Age and Health-Related Covariates by Participants' Vital Status in 2003

		Mortality Outcome										
		All causes		Coronary heart disease		Stroke		Cancer		Other causes		Total sample
		C	D	C	D	C	D	C	D	C	D	
	N	169	1693	1217	645	1727	135	1475	387	1526	336	
Age (years)	mean	**43.75**	**47.62**	**47.04**	**47.69**	**47.17**	**48.53**	47.26	47.29	47.20	47.56	47.27
	SD	3.17	4.27	4.30	4.35	4.32	4.19	4.37	4.14	4.30	4.41	4.32
Education (years)	mean	**12.26**	**11.18**	**11.39**	**11.05**	11.26	11.43	11.32	11.12	11.26	11.33	11.28
	SD	2.20	2.50	2.53	2.41	2.48	2.66	2.49	2.50	2.48	2.58	2.50
Systolic blood pressure (mm Hg)	mean	**126.76**	**134.94**	**132.65**	**137.12**	133.93	137.56	134.45	133.22	**134.99**	**130.60**	134.20
	SD	13.33	18.68	17.36	19.91	18.22	20.43	18.60	17.62	18.68	16.62	18.40
Heart rate (bpm)	mean	**68.51**	**72.24**	71.72	72.24	71.93	71.45	71.70	72.66	72.08	71.06	71.90
	SD	11.01	11.80	11.63	12.05	11.80	11.54	11.81	11.64	11.93	11.01	11.77
Serum cholesterol (mg/dl)	mean	247.41	247.83	**244.27**	**254.43**	247.74	248.42	249.09	242.83	248.37	245.14	247.79
	SD	61.28	52.84	52.63	54.92	52.85	63.10	54.55	49.78	54.30	50.50	53.64
Body mass index	mean	**24.57**	**25.51**	**25.16**	**25.91**	25.43	25.33	25.50	25.13	25.49	25.11	25.42
	SD	2.88	3.27	3.18	3.31	3.26	3.01	3.26	3.16	3.20	3.43	3.24
Cigarette smoking (num/day)	mean	**6.36**	**10.92**	10.36	10.79	10.65	8.73	**10.00**	**12.46**	10.55	10.33	10.51
	SD	8.47	11.54	11.38	11.36	11.45	10.18	11.13	12.09	11.41	11.24	11.37
Alcohol consumption (ml/day)	mean	**11.09**	**16.31**	16.05	15.42	15.87	15.30	15.19	18.27	15.65	16.68	15.83
	SD	14.78	21.10	20.28	21.37	20.73	19.78	20.01	22.82	20.81	19.95	20.66

Note. C = censored because participant is alive or died from another cause, D = deceased. Age and health related covariates at baseline. Means in boldface were found to be significantly different with a Welch's *t*-test and prevailed Bonferroni adjustment for the familywise error rate, that is, $p < 0.00625$.

Table 4

Hazard Ratios and 95% Confidence Intervals for Associations between Factor Scales and Death from All Causes, Coronary Heart Disease, Stroke, Cancer, and Death from Other Causes in 1862 participants

	All causes					
	N_{deaths} = 1693					
Factor	Model	*HR*	*L95*	*U95*	*p*	*p*-adjusted
Neuroticism	1	1.03	0.99	1.08	.17	.22
	2	1.02	0.97	1.07	.45	.52
	3	1.02	0.93	1.11	.71	.91
Cynicism	1	1.11	1.06	1.16	< .001	< .001
	2	1.06	1.01	1.12	.019	.17
	3	1.10	1.02	1.18	.011	.049
Psychoticism	1	1.03	0.98	1.08	.25	.28
	2	1.02	0.97	1.07	.45	.52
	3	1.01	0.94	1.07	.84	.91
Masculinity vs. femininity	1	0.99	0.95	1.04	.83	.83
	2	1.00	0.95	1.05	.89	.89
	3	1.00	0.94	1.05	.91	.91
Extraversion	1	1.06	1.01	1.11	.022	.097
	2	1.02	0.97	1.07	.42	.52
	3	0.99	0.93	1.05	.70	.91
Religious orthodoxy	1	0.96	0.92	1.01	.081	.12
	2	0.98	0.93	1.03	.46	.52
	3	0.98	0.93	1.03	.42	.76
Somatic complaints	1	1.05	1.00	1.10	.056	.12
	2	1.02	0.97	1.07	.36	.52
	3	1.03	0.97	1.10	.31	.69
Inadequacy	1	0.96	0.91	1.00	.065	.12
	2	0.96	0.91	1.01	.083	.37
	3	0.89	0.83	0.96	.001	.013
Intellectual interests	1	0.96	0.91	1.00	.071	.12
	2	0.98	0.94	1.03	.46	.52
	3	0.97	0.92	1.02	.21	.64
	Coronary heart disease					
	N_{deaths} = 645					
Factor	Model	*HR*	*L95*	*U95*	*p*	*p-adjusted*
Neuroticism	1	1.02	0.95	1.11	.53	.68
	2	1.02	0.94	1.10	.66	.75
	3	0.95	0.83	1.10	.50	.64

Cynicism	1	1.11	1.03	1.19	.009	.082
	2	1.05	0.96	1.14	.28	.52
	3	1.05	0.93	1.18	.42	.64
Psychoticism	1	1.06	0.99	1.14	.098	.30
	2	1.05	0.98	1.13	.17	.52
	3	1.04	0.94	1.15	.42	.64
Masculinity vs. femininity	1	0.96	0.89	1.04	.33	.59
	2	0.95	0.88	1.03	.23	.52
	3	0.97	0.89	1.06	.47	.64
Extraversion	1	1.04	0.97	1.13	.28	.59
	2	1.02	0.94	1.10	.67	.75
	3	0.99	0.91	1.09	.87	.87
Religious orthodoxy	1	1.03	0.96	1.11	.41	.61
	2	1.04	0.96	1.13	.29	.52
	3	1.03	0.95	1.12	.45	.64
Somatic complaints	1	1.08	1.01	1.17	.035	.16
	2	1.05	0.98	1.14	.18	.52
	3	1.07	0.97	1.17	.19	.64
Inadequacy	1	0.98	0.91	1.06	.64	.72
	2	0.99	0.92	1.07	.82	.82
	3	0.95	0.84	1.07	.39	.64
Intellectual interests	1	1.01	0.93	1.09	.89	.89
	2	1.03	0.95	1.12	.44	.66
	3	1.02	0.94	1.11	.63	.70

Stroke

N_{deaths} = 135

Factor	Model	*HR*	*L95*	*U95*	*p*	*p*-adjusted
Neuroticism	1	1.00	0.84	1.18	.98	.98
	2	1.01	0.85	1.20	.92	.98
	3	1.00	0.73	1.35	.99	.99
Cynicism	1	1.08	0.91	1.27	.38	.98
	2	1.08	0.91	1.30	.38	.98
	3	1.14	0.88	1.46	.32	.99
Psychoticism	1	0.99	0.83	1.17	.89	.98
	2	1.02	0.86	1.21	.84	.98
	3	1.00	0.79	1.26	.98	.99
Masculinity vs. femininity	1	1.03	0.87	1.22	.76	.98
	2	1.02	0.86	1.22	.80	.98
	3	1.04	0.86	1.26	.71	.99
Extraversion	1	1.03	0.86	1.22	.80	.98
	2	1.01	0.85	1.20	.92	.98
	3	0.93	0.76	1.13	.45	.99
Religious orthodoxy	1	0.98	0.83	1.15	.78	.98

	2	1.00	0.84	1.18	.98	.98
	3	0.98	0.82	1.16	.82	.99
Somatic complaints	1	0.98	0.82	1.16	.80	.98
	2	0.99	0.83	1.18	.89	.98
	3	1.01	0.81	1.26	.91	.99
Inadequacy	1	0.93	0.79	1.11	.43	.98
	2	0.96	0.81	1.15	.67	.98
	3	0.93	0.72	1.20	.57	.99
Intellectual interests	1	1.12	0.94	1.34	.21	.98
	2	1.13	0.94	1.35	.19	.98
	3	1.14	0.94	1.40	.19	.99

Cancer

N_{deaths} = 387

Factor	Model	*HR*	*L95*	*U95*	*p*	*p*-adjust
Neuroticism	1	1.02	0.92	1.13	.69	.77
	2	0.99	0.89	1.09	.81	.81
	3	0.91	0.76	1.09	.32	.58
Cynicism	1	1.19	1.08	1.31	< .001	.003
	2	1.14	1.03	1.27	.012	.10
	3	1.27	1.10	1.47	.001	.012
Psychoticism	1	1.04	0.95	1.15	.38	.57
	2	1.02	0.92	1.13	.71	.79
	3	1.03	0.90	1.18	.66	.72
Masculinity vs. femininity	1	1.04	0.94	1.15	.47	.61
	2	1.06	0.95	1.17	.29	.53
	3	1.04	0.93	1.17	.47	.71
Extraversion	1	1.08	0.97	1.20	.15	.33
	2	1.03	0.93	1.14	.57	.79
	3	1.02	0.91	1.15	.72	.72
Religious orthodoxy	1	0.88	0.79	0.97	.010	.045
	2	0.91	0.82	1.01	.078	.23
	3	0.90	0.81	1.01	.063	.19
Somatic complaints	1	0.95	0.86	1.06	.35	.57
	2	0.91	0.82	1.02	.10	.23
	3	0.91	0.79	1.04	.15	.33
Inadequacy	1	1.00	0.90	1.10	.95	.95
	2	0.98	0.88	1.08	.65	.79
	3	0.97	0.83	1.12	.64	.72
Intellectual interests	1	0.89	0.80	0.98	.018	.053
	2	0.92	0.83	1.01	.091	.23
	3	0.90	0.80	1.00	.045	.19

Other causes

	N_{deaths} = 336				
Factor	Model	*HR*	*L95*	*U95*	*p*	*p*-adjusted
Neuroticism	1	1.07	0.97	1.19	.17	.27
	2	1.06	0.95	1.18	.28	.54
	3	1.27	1.04	1.55	.020	.089
Cynicism	1	1.04	0.94	1.16	.43	.55
	2	1.00	0.90	1.13	.94	.94
	3	0.98	0.83	1.15	.79	.87
Psychoticism	1	0.98	0.88	1.09	.74	.83
	2	0.96	0.86	1.08	.52	.67
	3	0.91	0.77	1.07	.26	.46
Masculinity vs. femininity	1	0.99	0.89	1.10	.84	.84
	2	1.00	0.89	1.11	.93	.94
	3	0.99	0.88	1.12	.87	.87
Extraversion	1	1.12	1.00	1.25	.048	.15
	2	1.06	0.95	1.19	.30	.54
	3	1.01	0.89	1.16	.83	.87
Religious orthodoxy	1	0.91	0.82	1.01	.066	.15
	2	0.93	0.83	1.04	.19	.54
	3	0.95	0.85	1.06	.38	.56
Somatic complaints	1	1.13	1.02	1.26	.015	.14
	2	1.11	1.00	1.23	.045	.20
	3	1.15	1.00	1.31	.042	.13
Inadequacy	1	0.90	0.80	1.00	.053	.15
	2	0.89	0.80	1.00	.042	.20
	3	0.74	0.62	0.87	< .001	.003
Intellectual interests	1	0.93	0.83	1.04	.18	.27
	2	0.95	0.85	1.06	.37	.55
	3	0.93	0.82	1.05	.21	.46

Note. *HR* = Hazard ratio, *L95* = lower 95% confidence interval, *U95* = upper 95% confidence interval, *p*-adjusted = *p*-values adjusted for the false discovery rate using the Benjamini and Hochberg correction. 1 = effect in model adjusted for age, 2 = effect in model adjusted for age, education, systolic blood pressure, heart rate, serum cholesterol, body mass index, cigarette smoking, and alcohol consumption, 3 = effect in model adjusted for age, education, systolic blood pressure, heart rate, serum cholesterol, body mass index, cigarette smoking, and alcohol consumption, and the other eight factor scales.

Supplementary Tables

Table S1

Correlations Between MMPI Content Factors and the Domains and Facets of the NEO Personality Inventory

	MMPI Content Factor								
NEO-PI Scale	N	P	SC	I	C	E	II	RO	MF
Neuroticism	.67***a	.40***a	.30***a	.56***	.28***a				-.45***
N1: Anxiety	.62***a	.35***a	.23**a	.45***	.24**				-.51***a
N2: Hostility	.49***a	.25**a	.19*	.21*	.23**a				-.18**
N3 Depression	.59***a	.39***a	.18*a	.43***	.23**	-.18*			-.23**
N4: Self-Consciousness	.45***a	.24**	.27**	.59***		-.29***			-.35***
N5: Impulsiveness	.38***a	.26**a		.33***	.23**a			-.18*	-.28***
N6: Vulnerability	.41***a	.27***a	.29***a	.49***	.17*				-.42***a
Extraversion		-.21*	-.23**	-.48***a		.50***a			
E1: Warmth	-.24**a			-.37***		.40***a	.18*		
E2: Gregariousness		-.19*	-.21*	-.32***		.48***a			
E3: Assertiveness				-.55***a		.29***a			.32**
E4: Activity			-.19*a	-.28***a		.19*			
E5: Excitement Seeking					.29***a	.31***a		-.24**a	.26**
E6: Positive Emotions		-.18*	-.20*			.28***a			
Openness to Experience							.48***a		-.23**a
O1: Fantasy									-.15*a
O2: Aesthetics							.48***a		-.27**a
O3: Feelings	.18*					.23**a			-.29***a
O4: Actions				-.25**	-.17*		.34***		
O5: Ideas	-.18*			-.23**			.47***a		
O6: Values								-.56***a	
Agreeableness	-.43***a	-.31***a			-.51***a		.22*a	.29***	
Conscientiousness	-.37***a	-.39***a	-.26**	-.43***	-.31***a			.23**a	

Note. Table adapted from Tables 3 and 4 in Costa et al. (1986). *n* = 141; N = neuroticism, P = psychoticism, SC = somatic complaints, I = inadequacy, C = cynicism, E = extraversion, II = intellectual interests, RO = religious orthodoxy, MF = masculinity vs. femininity.

[a] Correlation replicated in peer ratings (n = 80, p < .05, one-tailed)

*$p < .05$. **$p < .01$. ***$p < .001$.

Table S2

Full Results for Age-Adjusted Models

	All causes 1693 deaths				Coronary heart disease 645 deaths				Stroke 135 deaths				Cancer 387 deaths				Other causes 336 deaths			
	HR	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*
Age	1.45	1.38	1.52	< 0.001	1.41	1.30	1.52	< 0.001	1.88	1.58	2.23	< 0.001	1.28	1.16	1.41	< 0.001	1.61	1.45	1.80	< 0.001
N	1.03	0.99	1.08	0.173	1.02	0.95	1.11	0.526	1.00	0.84	1.18	0.983	1.02	0.92	1.13	0.687	1.07	0.97	1.19	0.171
Age	1.44	1.37	1.51	< 0.001	1.40	1.29	1.51	< 0.001	1.87	1.57	2.22	< 0.001	1.26	1.14	1.40	< 0.001	1.61	1.45	1.80	< 0.001
C	1.11	1.06	1.16	< 0.001	1.11	1.03	1.19	0.009	1.08	0.91	1.27	0.383	1.19	1.08	1.31	< 0.001	1.04	0.94	1.16	0.429
Age	1.45	1.38	1.52	< 0.001	1.40	1.29	1.51	< 0.001	1.88	1.58	2.24	< 0.001	1.27	1.15	1.41	< 0.001	1.62	1.46	1.81	< 0.001
P	1.03	0.98	1.08	0.248	1.06	0.99	1.14	0.098	0.99	0.83	1.17	0.893	1.04	0.95	1.15	0.381	0.98	0.88	1.09	0.740
Age	1.45	1.38	1.52	< 0.001	1.40	1.29	1.51	< 0.001	1.88	1.58	2.24	< 0.001	1.29	1.16	1.42	< 0.001	1.62	1.45	1.80	< 0.001
MF	0.99	0.95	1.04	0.831	0.96	0.89	1.04	0.329	1.03	0.87	1.22	0.760	1.04	0.94	1.15	0.474	0.99	0.89	1.10	0.844
Age	1.45	1.38	1.52	< 0.001	1.41	1.30	1.52	< 0.001	1.88	1.58	2.23	< 0.001	1.28	1.16	1.42	< 0.001	1.62	1.45	1.80	< 0.001
E	1.06	1.01	1.11	0.022	1.04	0.97	1.13	0.280	1.03	0.86	1.22	0.777	1.08	0.97	1.20	0.146	1.12	1.00	1.25	0.048
Age	1.45	1.38	1.52	< 0.001	1.40	1.30	1.52	< 0.001	1.88	1.58	2.23	< 0.001	1.28	1.16	1.42	< 0.001	1.62	1.46	1.81	< 0.001
R	0.96	0.92	1.01	0.081	1.03	0.96	1.11	0.408	0.98	0.83	1.15	0.781	0.88	0.79	0.97	0.010	0.91	0.82	1.01	0.066
Age	1.44	1.37	1.51	< 0.001	1.39	1.29	1.51	< 0.001	1.88	1.58	2.24	< 0.001	1.29	1.16	1.42	< 0.001	1.59	1.42	1.77	< 0.001
SC	1.05	1.00	1.10	0.056	1.08	1.01	1.17	0.035	0.98	0.82	1.16	0.803	0.95	0.86	1.06	0.353	1.13	1.02	1.26	0.015
Age	1.45	1.38	1.52	< 0.001	1.41	1.30	1.52	< 0.001	1.89	1.59	2.24	< 0.001	1.28	1.16	1.41	< 0.001	1.63	1.46	1.82	< 0.001
I	0.96	0.91	1.00	0.065	0.98	0.91	1.06	0.644	0.93	0.79	1.11	0.434	1.00	0.90	1.10	0.950	0.90	0.80	1.00	0.053
Age	1.45	1.38	1.52	< 0.001	1.41	1.30	1.52	< 0.001	1.87	1.57	2.22	< 0.001	1.29	1.16	1.42	< 0.001	1.63	1.46	1.81	< 0.001
II	0.96	0.91	1.00	0.071	1.01	0.93	1.09	0.893	1.12	0.94	1.34	0.214	0.89	0.80	0.98	0.018	0.93	0.83	1.04	0.180

Note. N = Neuroticism, C = Cynicism, P = Psychoticism, MF = Masculinity vs. femininity, E = Extraversion, R = Religious orthodoxy, SC = Somatic complaints, I = Inadequacy, II = Intellectual Interests. *HR* = Hazard ratio, *L95* = lower 95% confidence interval, *U95* = upper 95% confidence interval.

Table S3

Full Results for Models Adjusted for Age, Education, Behavioral Risk Factors, and Biomedical Risk Factors

	All causes 1693 deaths				Coronary heart disease 645 deaths				Stroke 135 deaths				Cancer 387 deaths				Other causes 336 deaths			
	HR	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*
Age	1.46	1.39	1.54	< 0.001	1.38	1.28	1.50	< 0.001	1.88	1.57	2.24	< 0.001	1.32	1.19	1.47	< 0.001	1.68	1.50	1.87	< 0.001
Education	0.97	0.93	1.02	0.280	0.95	0.88	1.02	0.152	1.09	0.92	1.28	0.317	0.95	0.86	1.05	0.312	1.00	0.90	1.11	0.993
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.26	1.78	< 0.001	1.09	0.97	1.23	0.133	1.01	0.88	1.16	0.858
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.330	1.02	0.85	1.22	0.822	1.14	1.03	1.27	0.013	1.11	0.98	1.24	0.097
Serum cholesterol	1.01	0.96	1.05	0.822	1.13	1.05	1.22	0.001	1.00	0.84	1.18	0.972	0.93	0.84	1.03	0.143	0.97	0.87	1.08	0.554
Body mass index	1.10	1.05	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.20	0.927	0.97	0.87	1.08	0.617	1.05	0.93	1.19	0.398
Cigarette smoking	1.29	1.23	1.35	< 0.001	1.27	1.18	1.38	< 0.001	1.15	0.95	1.39	0.153	1.37	1.24	1.51	< 0.001	1.29	1.15	1.44	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.284	0.89	0.79	1.00	0.046	1.07	0.82	1.38	0.628	1.17	1.01	1.35	0.036	1.27	1.08	1.50	0.004
Alcohol consumption^2	1.00	0.99	1.02	0.776	1.03	1.01	1.06	0.018	0.99	0.93	1.06	0.808	0.99	0.95	1.02	0.462	0.96	0.92	1.01	0.162
N	1.02	0.97	1.07	0.451	1.02	0.94	1.10	0.661	1.01	0.85	1.20	0.916	0.99	0.89	1.09	0.811	1.06	0.95	1.18	0.284
Age	1.46	1.39	1.54	< 0.001	1.38	1.28	1.50	< 0.001	1.87	1.57	2.24	< 0.001	1.32	1.19	1.46	< 0.001	1.68	1.50	1.88	< 0.001
Education	0.99	0.94	1.04	0.705	0.96	0.88	1.04	0.287	1.11	0.94	1.32	0.225	0.99	0.89	1.10	0.866	0.99	0.89	1.11	0.917
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.25	1.77	< 0.001	1.09	0.97	1.23	0.132	1.01	0.88	1.16	0.872
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.325	1.02	0.85	1.22	0.807	1.14	1.03	1.27	0.014	1.10	0.98	1.24	0.103
Serum cholesterol	1.01	0.96	1.06	0.736	1.13	1.05	1.22	0.001	1.00	0.84	1.19	0.998	0.93	0.84	1.03	0.188	0.97	0.87	1.08	0.548
Body mass index	1.10	1.04	1.15	< 0.001	1.21	1.11	1.31	< 0.001	0.99	0.82	1.19	0.889	0.96	0.86	1.07	0.499	1.05	0.93	1.19	0.408
Cigarette smoking	1.29	1.23	1.35	< 0.001	1.27	1.18	1.38	< 0.001	1.15	0.95	1.39	0.160	1.36	1.23	1.50	< 0.001	1.29	1.15	1.44	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.305	0.89	0.79	1.00	0.044	1.06	0.82	1.37	0.660	1.16	1.00	1.34	0.043	1.27	1.08	1.50	0.004
Alcohol consumption^2	1.00	0.99	1.02	0.789	1.03	1.01	1.06	0.018	0.99	0.93	1.06	0.817	0.99	0.95	1.02	0.464	0.96	0.92	1.01	0.159
C	1.06	1.01	1.12	0.019	1.05	0.96	1.14	0.278	1.08	0.91	1.30	0.378	1.14	1.03	1.27	0.012	1.00	0.90	1.13	0.937
Age	1.46	1.39	1.54	< 0.001	1.38	1.27	1.49	< 0.001	1.88	1.57	2.24	< 0.001	1.32	1.19	1.46	< 0.001	1.69	1.51	1.89	< 0.001
Education	0.98	0.93	1.02	0.326	0.95	0.88	1.03	0.240	1.09	0.92	1.29	0.310	0.95	0.86	1.06	0.374	0.99	0.89	1.10	0.787
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.32	1.22	1.43	< 0.001	1.49	1.26	1.78	< 0.001	1.09	0.97	1.23	0.128	1.01	0.88	1.16	0.904
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.323	1.02	0.85	1.22	0.820	1.14	1.03	1.27	0.013	1.10	0.98	1.24	0.107
Serum cholesterol	1.01	0.96	1.05	0.809	1.13	1.05	1.22	0.001	1.00	0.84	1.18	0.979	0.93	0.84	1.03	0.148	0.97	0.87	1.07	0.528
Body mass index	1.10	1.05	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.19	0.923	0.97	0.87	1.08	0.611	1.05	0.93	1.19	0.393
Cigarette smoking	1.29	1.23	1.36	< 0.001	1.28	1.18	1.38	< 0.001	1.15	0.95	1.39	0.150	1.37	1.24	1.51	< 0.001	1.29	1.15	1.45	< 0.001

Alcohol consumption	1.04	0.97	1.12	0.279	0.89	0.79	1.00	0.045	1.07	0.82	1.38	0.630	1.17	1.01	1.35	0.037	1.27	1.08	1.50	0.004
Alcohol consumption^2	1.00	0.99	1.02	0.794	1.03	1.01	1.06	0.019	0.99	0.93	1.06	0.807	0.99	0.95	1.02	0.464	0.97	0.92	1.01	0.160
P	1.02	0.97	1.07	0.454	1.05	0.98	1.13	0.173	1.02	0.86	1.21	0.836	1.02	0.92	1.13	0.707	0.96	0.86	1.08	0.522
Age	1.46	1.39	1.54	< 0.001	1.38	1.27	1.49	< 0.001	1.88	1.58	2.25	< 0.001	1.33	1.20	1.48	< 0.001	1.68	1.50	1.88	< 0.001
Education	0.97	0.93	1.02	0.259	0.95	0.88	1.03	0.199	1.08	0.92	1.27	0.347	0.94	0.85	1.04	0.256	0.99	0.89	1.10	0.908
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.26	1.78	< 0.001	1.09	0.97	1.23	0.128	1.01	0.88	1.16	0.872
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.364	1.02	0.85	1.22	0.815	1.15	1.03	1.28	0.011	1.10	0.98	1.24	0.105
Serum cholesterol	1.01	0.96	1.05	0.824	1.13	1.05	1.22	0.001	1.00	0.84	1.18	0.958	0.92	0.83	1.02	0.125	0.97	0.87	1.08	0.551
Body mass index	1.10	1.05	1.16	< 0.001	1.22	1.12	1.32	< 0.001	0.99	0.82	1.19	0.902	0.97	0.87	1.08	0.562	1.05	0.93	1.19	0.400
Cigarette smoking	1.29	1.23	1.36	< 0.001	1.28	1.18	1.38	< 0.001	1.15	0.95	1.39	0.155	1.36	1.23	1.51	< 0.001	1.29	1.15	1.45	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.274	0.89	0.79	1.00	0.046	1.07	0.82	1.38	0.620	1.17	1.01	1.35	0.036	1.27	1.08	1.50	0.004
Alcohol consumption^2	1.00	0.99	1.02	0.786	1.03	1.01	1.06	0.018	0.99	0.93	1.06	0.797	0.99	0.95	1.02	0.448	0.97	0.92	1.01	0.160
MF	1.00	0.95	1.05	0.887	0.95	0.88	1.03	0.233	1.02	0.86	1.22	0.796	1.06	0.95	1.17	0.292	1.00	0.89	1.11	0.933
Age	1.47	1.39	1.54	< 0.001	1.38	1.28	1.50	< 0.001	1.88	1.57	2.24	< 0.001	1.32	1.19	1.47	< 0.001	1.68	1.50	1.87	< 0.001
Education	0.97	0.93	1.02	0.252	0.94	0.87	1.02	0.141	1.09	0.92	1.28	0.319	0.95	0.86	1.05	0.328	0.99	0.90	1.10	0.905
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.26	1.77	< 0.001	1.09	0.97	1.23	0.131	1.01	0.88	1.16	0.850
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.324	1.02	0.85	1.22	0.821	1.14	1.03	1.27	0.013	1.10	0.98	1.24	0.100
Serum cholesterol	1.01	0.96	1.05	0.810	1.13	1.05	1.22	0.001	1.00	0.84	1.18	0.974	0.93	0.84	1.03	0.150	0.97	0.87	1.08	0.575
Body mass index	1.10	1.05	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.19	0.920	0.97	0.87	1.08	0.593	1.05	0.93	1.18	0.465
Cigarette smoking	1.29	1.23	1.35	< 0.001	1.27	1.18	1.38	< 0.001	1.15	0.95	1.39	0.155	1.36	1.23	1.51	< 0.001	1.28	1.14	1.44	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.315	0.89	0.79	1.00	0.044	1.07	0.82	1.38	0.635	1.16	1.01	1.34	0.042	1.26	1.07	1.49	0.006
Alcohol consumption^2	1.00	0.99	1.02	0.737	1.03	1.01	1.06	0.017	0.99	0.93	1.06	0.813	0.99	0.96	1.02	0.492	0.97	0.92	1.02	0.177
E	1.02	0.97	1.07	0.417	1.02	0.94	1.10	0.666	1.01	0.85	1.20	0.918	1.03	0.93	1.14	0.573	1.06	0.95	1.19	0.301
Age	1.47	1.39	1.54	< 0.001	1.38	1.27	1.50	< 0.001	1.88	1.57	2.24	< 0.001	1.32	1.19	1.47	< 0.001	1.68	1.51	1.88	< 0.001
Education	0.97	0.93	1.02	0.208	0.95	0.88	1.03	0.183	1.09	0.92	1.28	0.326	0.94	0.85	1.04	0.210	0.98	0.89	1.09	0.762
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.26	1.77	< 0.001	1.09	0.97	1.23	0.134	1.01	0.88	1.16	0.899
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.344	1.02	0.85	1.22	0.822	1.15	1.03	1.27	0.012	1.11	0.98	1.24	0.094
Serum cholesterol	1.00	0.96	1.05	0.838	1.13	1.05	1.21	0.001	1.00	0.84	1.18	0.971	0.92	0.83	1.02	0.132	0.97	0.87	1.08	0.533
Body mass index	1.10	1.05	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.20	0.925	0.97	0.87	1.09	0.625	1.05	0.94	1.19	0.389
Cigarette smoking	1.29	1.23	1.35	< 0.001	1.28	1.18	1.39	< 0.001	1.15	0.95	1.39	0.154	1.35	1.22	1.50	< 0.001	1.28	1.15	1.44	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.318	0.90	0.80	1.01	0.068	1.07	0.82	1.39	0.630	1.15	0.99	1.33	0.061	1.26	1.07	1.48	0.007
Alcohol consumption^2	1.00	0.99	1.02	0.747	1.03	1.00	1.06	0.025	0.99	0.93	1.06	0.808	0.99	0.96	1.02	0.546	0.97	0.92	1.02	0.181

R	0.98	0.93	1.03	0.461	1.04	0.96	1.13	0.290	1.00	0.84	1.18	0.976	0.91	0.82	1.01	0.078	0.93	0.83	1.04	0.191
Age	1.46	1.39	1.54	< 0.001	1.38	1.27	1.49	< 0.001	1.88	1.57	2.25	< 0.001	1.33	1.20	1.48	< 0.001	1.65	1.48	1.85	< 0.001
Education	0.98	0.93	1.02	0.310	0.95	0.88	1.03	0.204	1.08	0.92	1.28	0.339	0.94	0.85	1.04	0.227	1.01	0.91	1.12	0.852
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.25	1.77	< 0.001	1.09	0.97	1.23	0.140	1.01	0.88	1.16	0.854
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.322	1.02	0.85	1.22	0.828	1.14	1.03	1.27	0.014	1.11	0.98	1.25	0.090
Serum cholesterol	1.00	0.96	1.05	0.852	1.13	1.05	1.21	0.001	1.00	0.84	1.18	0.976	0.93	0.84	1.03	0.151	0.96	0.86	1.07	0.481
Body mass index	1.10	1.05	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.20	0.924	0.97	0.87	1.09	0.631	1.05	0.93	1.18	0.407
Cigarette smoking	1.29	1.23	1.35	< 0.001	1.27	1.17	1.38	< 0.001	1.15	0.95	1.39	0.151	1.37	1.24	1.52	< 0.001	1.28	1.15	1.44	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.284	0.89	0.79	1.00	0.044	1.07	0.82	1.38	0.622	1.17	1.01	1.35	0.033	1.27	1.07	1.49	0.005
Alcohol consumption^2	1.00	0.99	1.02	0.789	1.03	1.01	1.06	0.018	0.99	0.93	1.06	0.806	0.99	0.95	1.02	0.471	0.96	0.92	1.01	0.161
SC	1.02	0.97	1.07	0.357	1.05	0.98	1.14	0.176	0.99	0.83	1.18	0.892	0.91	0.82	1.02	0.103	1.11	1.00	1.23	0.045
Age	1.47	1.40	1.54	< 0.001	1.38	1.28	1.50	< 0.001	1.88	1.57	2.25	< 0.001	1.32	1.19	1.47	< 0.001	1.69	1.51	1.89	< 0.001
Education	0.97	0.92	1.01	0.147	0.94	0.87	1.02	0.133	1.08	0.92	1.27	0.367	0.95	0.86	1.05	0.292	0.97	0.88	1.08	0.617
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.25	1.77	< 0.001	1.09	0.97	1.23	0.138	1.01	0.88	1.15	0.933
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.333	1.02	0.85	1.22	0.836	1.14	1.03	1.27	0.014	1.10	0.98	1.24	0.118
Serum cholesterol	1.00	0.96	1.05	0.841	1.13	1.05	1.21	0.001	1.00	0.84	1.18	0.968	0.93	0.84	1.03	0.142	0.97	0.87	1.07	0.529
Body mass index	1.10	1.04	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.19	0.898	0.97	0.87	1.08	0.598	1.04	0.93	1.18	0.480
Cigarette smoking	1.29	1.23	1.36	< 0.001	1.27	1.18	1.38	< 0.001	1.15	0.95	1.39	0.151	1.37	1.24	1.51	< 0.001	1.29	1.15	1.45	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.285	0.89	0.79	1.00	0.047	1.07	0.82	1.38	0.629	1.17	1.01	1.35	0.037	1.27	1.08	1.49	0.005
Alcohol consumption^2	1.00	0.99	1.02	0.757	1.03	1.01	1.06	0.018	0.99	0.93	1.06	0.813	0.99	0.95	1.02	0.469	0.97	0.92	1.01	0.172
I	0.96	0.91	1.01	0.083	0.99	0.92	1.07	0.824	0.96	0.81	1.15	0.672	0.98	0.88	1.08	0.654	0.89	0.80	1.00	0.042
Age	1.47	1.40	1.54	< 0.001	1.38	1.27	1.50	< 0.001	1.86	1.56	2.22	< 0.001	1.33	1.20	1.47	< 0.001	1.69	1.51	1.89	< 0.001
Education	0.97	0.93	1.02	0.284	0.94	0.87	1.02	0.117	1.07	0.91	1.26	0.429	0.96	0.87	1.06	0.430	1.00	0.90	1.11	0.974
Systolic blood pressure	1.22	1.16	1.29	< 0.001	1.31	1.21	1.42	< 0.001	1.49	1.25	1.77	< 0.001	1.09	0.97	1.23	0.128	1.01	0.88	1.16	0.892
Heart rate	1.10	1.04	1.15	< 0.001	1.04	0.96	1.13	0.328	1.02	0.85	1.22	0.823	1.14	1.03	1.27	0.014	1.10	0.98	1.24	0.103
Serum cholesterol	1.00	0.96	1.05	0.849	1.13	1.05	1.22	0.001	1.00	0.84	1.19	0.996	0.92	0.83	1.02	0.128	0.97	0.87	1.07	0.513
Body mass index	1.10	1.05	1.16	< 0.001	1.21	1.12	1.31	< 0.001	0.99	0.82	1.20	0.952	0.97	0.87	1.08	0.611	1.05	0.93	1.19	0.403
Cigarette smoking	1.29	1.23	1.36	< 0.001	1.27	1.18	1.38	< 0.001	1.15	0.95	1.39	0.150	1.37	1.24	1.51	< 0.001	1.29	1.15	1.45	< 0.001
Alcohol consumption	1.04	0.97	1.12	0.300	0.89	0.79	1.00	0.055	1.08	0.83	1.40	0.567	1.15	1.00	1.33	0.053	1.26	1.07	1.49	0.006
Alcohol consumption^2	1.00	0.99	1.02	0.786	1.03	1.01	1.06	0.019	0.99	0.93	1.06	0.812	0.99	0.95	1.02	0.480	0.97	0.92	1.01	0.162
II	0.98	0.94	1.03	0.460	1.03	0.95	1.12	0.437	1.13	0.94	1.35	0.193	0.92	0.83	1.01	0.091	0.95	0.85	1.06	0.368

Note. Systolic blood pressure measured in MM Hg, heart rate measured in beats per minute, serum cholesterol measured in mg/dl, cigarette smoking measured in number of cigarettes smoked per day, alcohol consumption measured in ml per day. N = Neuroticism, C = Cynicism, P = Psychoticism, MF = Masculinity vs. femininity, E = Extraversion, R = Religious orthodoxy, SC = Somatic complaints, I = Inadequacy, II = Intellectual Interests. *HR* = Hazard ratio, *L95* = lower 95% confidence interval, *U95* = upper 95% confidence interval.

Table S4

Full Results for Models that Included All Nine Factor Scales, Adjusting for Age, Education, Behavioral Risk Factors, and Biomedical Risk Factors

	All causes 1693 deaths				Coronary heart disease 645 deaths				Stroke 135 deaths				Cancer 387 deaths				Other causes 336 deaths			
	HR	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*	*HR*	*L95*	*U95*	*p*
Age	1.46	1.39	1.54	< 0.001	1.36	1.26	1.48	< 0.001	1.86	1.56	2.23	< 0.001	1.35	1.21	1.50	< 0.001	1.68	1.50	1.88	< 0.001
Education	0.99	0.94	1.04	0.659	0.97	0.89	1.05	0.460	1.08	0.91	1.30	0.383	0.99	0.89	1.11	0.917	0.97	0.86	1.08	0.557
Systolic blood pressure	1.22	1.15	1.28	< 0.001	1.31	1.21	1.42	< 0.001	1.48	1.25	1.76	< 0.001	1.09	0.97	1.23	0.142	0.99	0.87	1.14	0.922
Heart rate	1.09	1.04	1.15	0.001	1.04	0.96	1.13	0.354	1.02	0.85	1.22	0.817	1.15	1.03	1.27	0.013	1.10	0.98	1.24	0.100
Serum cholesterol	1.01	0.96	1.06	0.770	1.13	1.05	1.22	0.001	1.00	0.84	1.19	0.997	0.93	0.84	1.03	0.181	0.95	0.86	1.06	0.401
Body mass index	1.08	1.03	1.14	0.002	1.20	1.11	1.30	< 0.001	0.98	0.81	1.19	0.848	0.95	0.85	1.06	0.350	1.03	0.92	1.17	0.599
Cigarette smoking	1.28	1.22	1.35	< 0.001	1.28	1.18	1.39	< 0.001	1.15	0.95	1.39	0.159	1.36	1.22	1.50	< 0.001	1.27	1.13	1.42	< 0.001
Alcohol consumption	1.03	0.95	1.10	0.494	0.89	0.79	1.01	0.065	1.08	0.83	1.41	0.572	1.12	0.97	1.30	0.124	1.24	1.05	1.46	0.013
Alcohol consumption	1.00	0.99	1.02	0.670	1.03	1.00	1.06	0.024	0.99	0.93	1.06	0.787	0.99	0.96	1.02	0.567	0.97	0.93	1.02	0.240
N	1.02	0.93	1.11	0.715	0.95	0.83	1.10	0.499	1.00	0.73	1.35	0.989	0.91	0.76	1.09	0.321	1.27	1.04	1.55	0.020
C	1.10	1.02	1.18	0.011	1.05	0.93	1.18	0.421	1.14	0.88	1.46	0.318	1.27	1.10	1.47	0.001	0.98	0.83	1.15	0.786
P	1.01	0.94	1.07	0.840	1.04	0.94	1.15	0.421	1.00	0.79	1.26	0.978	1.03	0.90	1.18	0.660	0.91	0.77	1.07	0.257
MF	1.00	0.94	1.05	0.915	0.97	0.89	1.06	0.468	1.04	0.86	1.26	0.712	1.04	0.93	1.17	0.471	0.99	0.88	1.12	0.868
E	0.99	0.93	1.05	0.699	0.99	0.91	1.09	0.874	0.93	0.76	1.13	0.447	1.02	0.91	1.15	0.717	1.01	0.89	1.16	0.833
R	0.98	0.93	1.03	0.424	1.03	0.95	1.12	0.447	0.98	0.82	1.16	0.815	0.90	0.81	1.01	0.063	0.95	0.85	1.06	0.376
SC	1.03	0.97	1.10	0.307	1.07	0.97	1.17	0.188	1.01	0.81	1.26	0.913	0.91	0.79	1.04	0.147	1.15	1.00	1.31	0.042
I	0.89	0.83	0.96	0.001	0.95	0.84	1.07	0.389	0.93	0.72	1.20	0.570	0.97	0.83	1.12	0.644	0.74	0.62	0.87	< 0.001
II	0.97	0.92	1.02	0.212	1.02	0.94	1.11	0.626	1.14	0.94	1.40	0.192	0.90	0.80	1.00	0.045	0.93	0.82	1.05	0.215

Note. Systolic blood pressure measured in MM Hg, heart rate measured in beats per minute, serum cholesterol measured in mg/dl, cigarette smoking measured in number of cigarettes smoked per day, alcohol consumption measured in ml per day. N = Neuroticism, C = Cynicism, P = Psychoticism, MF = Masculinity vs. femininity, E = Extraversion, R = Religious orthodoxy, SC = Somatic complaints, I = Inadequacy, II = Intellectual Interests. *HR* = Hazard ratio, *L95* = lower 95% confidence interval, *U95* = upper 95% confidence interval.

Table S5

Tests of Whether Effects of Variables in Models Predicting Death from All Causes, Coronary Heart Disease, Stroke, Cancer, and All Other Causes Vary as a Function of Follow-up Time/Violate the Proportional Hazards Assumption

	All causes			Coronary heart disease			Stroke			Cancer			Other causes		
Effect	rho	χ^2	*p*	rho	χ^2	*p*	rho	χ^2	*p*	rho	χ^2	*p*	rho	χ^2	*p*
Age	0.00	0.01	0.90	-0.03	0.69	0.41	-0.05	0.36	0.55	-0.13	5.65	0.02	0.03	0.25	0.62
Educational achievement (years)	-0.06	5.81	0.02	-0.04	0.70	0.40	-0.16	3.79	0.05	-0.08	2.69	0.10	-0.01	0.07	0.79
Systolic blood pressure (mm Hg)	-0.07	8.35	< 0.001	-0.05	1.97	0.16	-0.11	1.82	0.18	-0.05	0.94	0.33	-0.02	0.20	0.65
Heart rate (bpm)	-0.02	0.63	0.43	-0.01	0.15	0.70	0.07	0.65	0.42	-0.03	0.29	0.59	-0.06	1.26	0.26
Serum cholesterol (mg/dl)	-0.07	7.96	< 0.001	-0.08	4.05	0.04	-0.03	0.22	0.64	-0.05	0.81	0.37	-0.04	0.45	0.50
Body mass index	0.03	1.33	0.25	0.08	4.22	0.04	-0.01	0.01	0.93	-0.02	0.10	0.75	0.03	0.41	0.52
Cigarette smoking (num/day)	-0.07	8.35	< 0.001	-0.11	6.64	0.01	-0.16	2.87	0.09	-0.05	1.03	0.31	-0.01	0.04	0.84
Alcohol consumption (ml/day)	0.05	4.96	0.03	0.09	6.45	0.01	0.03	0.14	0.71	-0.01	0.05	0.82	-0.06	1.39	0.24
Alcohol consumption (ml/day)^2	-0.04	2.18	0.14	-0.03	0.64	0.42	-0.03	0.08	0.78	-0.02	0.14	0.71	0.03	0.32	0.57
Neuroticism	0.01	0.25	0.61	-0.02	0.26	0.61	0.02	0.07	0.79	-0.08	2.57	0.11	-0.01	0.03	0.86
Cynicism	-0.06	6.89	0.01	-0.05	1.89	0.17	-0.11	1.58	0.21	0.04	0.61	0.44	-0.08	2.28	0.13
Psychoticism	0.01	0.07	0.79	0.01	0.03	0.87	-0.03	0.16	0.69	0.00	0.00	0.97	0.08	2.58	0.11
Masculinity vs. femininity	0.01	0.16	0.69	0.04	1.21	0.27	-0.03	0.09	0.76	0.02	0.15	0.70	-0.06	1.16	0.28
Extraversion	0.03	1.38	0.24	0.03	0.73	0.39	0.01	0.00	0.95	0.08	2.44	0.12	0.00	0.01	0.94
Religious orthodoxy	0.00	0.01	0.92	0.04	1.10	0.29	-0.07	0.68	0.41	-0.01	0.01	0.91	0.00	0.00	0.97
Somatic complaints	-0.02	0.44	0.51	0.03	0.42	0.52	-0.01	0.02	0.88	-0.01	0.09	0.77	-0.06	1.16	0.28
Inadequacy	0.00	0.04	0.84	0.03	0.54	0.46	0.04	0.24	0.62	0.03	0.37	0.54	0.03	0.29	0.59
Intellectual interests	-0.01	0.14	0.71	0.04	0.98	0.32	0.09	1.07	0.30	-0.07	2.04	0.15	-0.08	2.05	0.15
Global test	---	44.93	< 0.001	---	31.62	0.02	---	10.63	0.91	---	23.52	0.17	---	14.40	0.70

Note. rho = correlation between Kaplan-Meier transformed survival time and scaled Schoenfeld residuals. There is no estimate of rho for the global test.

Table S6

Hazard Ratios and Hazard Ratios by Period for Risk of Death from All Causes and Baseline Age, Behavioral Risk Factors, Biomedical Risk Factors, and the Factor Scales

	HR	*L95*	*U95*	*p*
Age	1.46	1.39	1.54	< .001
Educational achievement in years (< 20 years)	1.03	0.93	1.14	.56
Educational achievement in years (20-29 years)	1.04	0.95	1.14	.45
Educational achievement in years (30-34 years)	0.98	0.87	1.11	.75
Educational achievement in years (≥ 35 years)	0.91	0.84	1.00	.044
Systolic blood pressure in mm Hg (< 20 years)	1.29	1.18	1.40	< .001
Systolic blood pressure in mm Hg (20-29 years)	1.28	1.17	1.39	< .001
Systolic blood pressure in mm Hg (30-34 years)	1.14	1.00	1.30	.058
Systolic blood pressure in mm Hg (≥ 35 years)	1.07	0.95	1.20	.28
Heart rate (bpm)	1.10	1.04	1.16	< .001
Serum cholesterol in mg/dl (< 20 years)	1.07	0.98	1.17	.15
Serum cholesterol in mg/dl (20-29 years)	1.06	0.97	1.16	.19
Serum cholesterol in mg/dl (30-34 years)	1.00	0.89	1.14	.95
Serum cholesterol in mg/dl (≥ 35 years)	0.91	0.83	0.99	.031
Body mass index	1.09	1.03	1.15	.001
Number of cigarettes smoked per day (< 20 years)	1.39	1.27	1.51	< .001
Number of cigarettes smoked per day (20-29 years)	1.35	1.23	1.47	< .001
Number of cigarettes smoked per day (30-34 years)	1.11	0.98	1.27	.11
Number of cigarettes smoked per day (≥ 35 years)	1.18	1.06	1.30	.002
Alcohol consumption in ml per day (< 20 years)	0.96	0.86	1.06	.44
Alcohol consumption in ml per day (20-29 years)	0.98	0.89	1.09	.76
Alcohol consumption in ml per day (30-34 years)	1.05	0.92	1.21	.44
Alcohol consumption in ml per day (≥ 35 years)	1.13	1.00	1.27	.049
Alcohol consumption $(ml/day)^2$	1.01	0.99	1.03	.42
Neuroticism	1.02	0.94	1.11	.62
Cynicism (< 20 years)	1.19	1.07	1.33	.002
Cynicism (20-29 years)	1.11	1.00	1.24	.041
Cynicism (30-34 years)	1.03	0.90	1.19	.63
Cynicism (≥ 35 years)	1.01	0.91	1.13	.85
Psychoticism	1.01	0.94	1.08	.80
Masculinity vs. femininity	1.00	0.95	1.06	.90
Extraversion	1.00	0.94	1.05	.88
Religious orthodoxy	0.98	0.93	1.03	.46
Somatic complaints	1.03	0.97	1.10	.30
Inadequacy	0.89	0.83	0.96	.002
Intellectual interests	0.96	0.91	1.01	.11

Note. The sample consisted of 1862 participants of whom 1693 died. The effects of educational achievement, systolic blood pressure, serum cholesterol, cigarette smoking, alcohol consumption, and cynicism varied as a function of follow-up time, and so were modeled as time-varying coefficients. *HR* = hazard ratio associated with one standard deviation of each predictor. *L95* and *U95* refer to the lower and upper bounds of the 95% confidence interval, respectively.

Table S7

Full Results for Age-Adjusted Models of Associations between MMPI Factor Scales and Death from Any Disease of the Circulatory System During the 45-year Follow-Up

	HR	*L95*	*U95*	*p*	*p*-adjusted
Age	1.48	1.39	1.58	< 0.001	
Neuroticism	1.00	0.94	1.07	0.88	> 0.99
Age	1.47	1.38	1.57	< 0.001	
Cynicism	1.09	1.02	1.16	0.008	0.072
Age	1.48	1.38	1.58	< 0.001	
Psychoticism	1.03	0.96	1.09	0.42	> 0.99
Age	1.48	1.38	1.58	< 0.001	
Masculinity vs. femininity	0.99	0.92	1.05	0.67	> 0.99
Age	1.48	1.39	1.58	< 0.001	
Extraversion	1.04	0.97	1.11	0.25	> 0.99
Age	1.48	1.39	1.58	< 0.001	
Religious orthodoxy	1.03	0.97	1.10	0.35	> 0.99
Age	1.47	1.38	1.57	< 0.001	
Somatic complaints	1.05	0.98	1.12	0.16	> 0.99
Age	1.48	1.39	1.58	< 0.001	
Inadequacy	0.96	0.90	1.02	0.17	> 0.99
Age	1.48	1.39	1.58	< 0.001	
Intellectual interests	1.01	0.94	1.08	0.81	> 0.99

Note. The sample included 1862 participants of whom 923 died. *HR* = hazard ratio associated with one standard deviation of each predictor. *L95* and *U95* refer to the lower and upper bounds of the 95% confidence interval, respectively. *p*-adjusted refers to the significance level adjusted for the false discovery rate using Benjamini and Hochberg's procedure.

Table S8

Full Results for Associations Between Factor Scales and Death from Any Disease of the Circulatory System During the 45-year Follow-Up in Models Adjusting for Age, Education, Behavioral Risk Factors, and Biomedical Risk Factors

	HR	*L95*	*U95*	*p*
Age	1.46	1.37	1.57	< 0.001
Education	0.96	0.91	1.03	0.27
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.056
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.047
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.01	0.066
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.059
Neuroticism	1.00	0.94	1.07	> 0.99
Age	1.46	1.37	1.57	< 0.001
Education	0.98	0.91	1.04	0.48
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.054
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.042
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.00	0.060
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.059
Cynicism	1.04	0.97	1.11	0.27
Age	1.46	1.37	1.56	< 0.001
Education	0.97	0.91	1.03	0.35
Systolic blood pressure in mm Hg	1.35	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.054
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.044
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.01	0.064
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.060
Psychoticism	1.02	0.96	1.09	0.48
Age	1.46	1.37	1.56	< 0.001
Education	0.97	0.91	1.03	0.32
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.060

Serum cholesterol in mg/dl	1.07	1.00	1.14	0.043
Body mass index	1.17	1.10	1.26	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.01	0.065
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.058
Masculinity vs. femininity	0.98	0.92	1.05	0.57
Age	1.47	1.37	1.57	< 0.001
Education	0.97	0.91	1.03	0.27
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.054
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.045
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.00	0.061
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.055
Extraversion	1.01	0.95	1.08	0.69
Age	1.46	1.37	1.56	< 0.001
Education	0.97	0.91	1.03	0.35
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.061
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.046
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.27	1.19	1.36	< 0.001
Alcohol consumption in ml per day	0.92	0.83	1.01	0.095
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.076
Religious orthodoxy	1.04	0.98	1.11	0.22
Age	1.46	1.37	1.56	< 0.001
Education	0.97	0.91	1.03	0.33
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.054
Serum cholesterol in mg/dl	1.07	1.00	1.13	0.049
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.01	0.063
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.059
Somatic complaints	1.03	0.96	1.09	0.45
Age	1.47	1.37	1.57	< 0.001
Education	0.96	0.90	1.02	0.21
Systolic blood pressure in mm Hg	1.34	1.25	1.43	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.059

Serum cholesterol in mg/dl	1.07	1.00	1.14	0.047
Body mass index	1.17	1.09	1.25	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.82	1.01	0.064
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.056
Inadequacy	0.97	0.90	1.03	0.33
Age	1.46	1.37	1.56	< 0.001
Education	0.96	0.90	1.02	0.23
Systolic blood pressure in mm Hg	1.34	1.26	1.44	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.055
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.044
Body mass index	1.17	1.09	1.26	< 0.001
Number of cigarettes smoked per day	1.26	1.18	1.35	< 0.001
Alcohol consumption in ml per day	0.91	0.83	1.01	0.077
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.059
Intellectual interests	1.03	0.96	1.10	0.37

Note. The sample included 1862 participants of whom 923 died. *HR* = hazard ratio associated with one standard deviation of each predictor. *L95* and *U95* refer to the lower and upper bounds of the 95% confidence interval, respectively.

Table S9

Associations Between Factor Scales and Death from Any Disease of the Circulatory System in a Full Model that Included Age, Education, Behavioral Risk Factors, Biomedical Risk Factors, and All Factor Scales

	HR	*L95*	*U95*	*p*
Age	1.45	1.36	1.55	< 0.001
Education	0.98	0.92	1.05	0.62
Systolic blood pressure in mm Hg	1.34	1.25	1.43	< 0.001
Heart rate (bpm)	1.07	1.00	1.14	0.066
Serum cholesterol in mg/dl	1.07	1.00	1.14	0.042
Body mass index	1.16	1.08	1.24	< 0.001
Number of cigarettes smoked per day	1.27	1.18	1.36	< 0.001
Alcohol consumption in ml per day	0.92	0.83	1.01	0.092
Alcohol consumption $(ml/day)^2$	1.02	1.00	1.05	0.075
Neuroticism	0.97	0.86	1.09	0.64
Cynicism	1.06	0.97	1.17	0.21
Psychoticism	1.02	0.93	1.11	0.67
Masculinity vs. femininity	0.99	0.92	1.06	0.73
Extraversion	0.98	0.91	1.06	0.63
Religious orthodoxy	1.03	0.97	1.10	0.34
Somatic complaints	1.05	0.97	1.14	0.27
Inadequacy	0.93	0.84	1.03	0.15
Intellectual interests	1.02	0.95	1.10	0.59

Note. The sample included 1862 participants of whom 923 died. *HR* = hazard ratio associated with one standard deviation of each predictor. *L95* and *U95* refer to the lower and upper bounds of the 95% confidence interval, respectively.

Table S10

Tests of Whether Effects of Covariates or Factor Scales in Models Predicting Death from Circulatory Diseases Vary as a Function of Follow-Up Time/Violate the Proportional Hazards Assumption

	rho	χ^2	*p*
Age	0.00	0.00	0.98
Educational achievement (years)	-0.07	4.75	0.03
Systolic blood pressure (mm Hg)	-0.06	3.82	0.05
Heart rate (bpm)	0.00	0.02	0.89
Serum cholesterol (mg/dl)	-0.10	9.22	< 0.001
Body mass index	0.06	3.18	0.07
Cigarettes smoking (num/day)	-0.11	11.04	< 0.001
Alcohol consumption (ml/day)	0.08	6.12	0.01
Alcohol consumption (ml/day)^2	-0.03	0.79	0.37
Neuroticism	0.01	0.20	0.65
Cynicism	-0.06	3.18	0.07
Psychoticism	0.01	0.03	0.86
Masculinity vs. femininity	0.03	1.14	0.28
Extraversion	0.02	0.49	0.48
Religious orthodoxy	0.00	0.00	> 0.99
Somatic complaints	-0.01	0.14	0.71
Inadequacy	0.02	0.25	0.62
Intellectual interests	0.03	1.10	0.29
Global test	---	39.15	< 0.001

Note. rho = Correlation between Kaplan-Meier transformed survival time and scaled Schoenfeld residuals. There is no estimate of rho for the global test